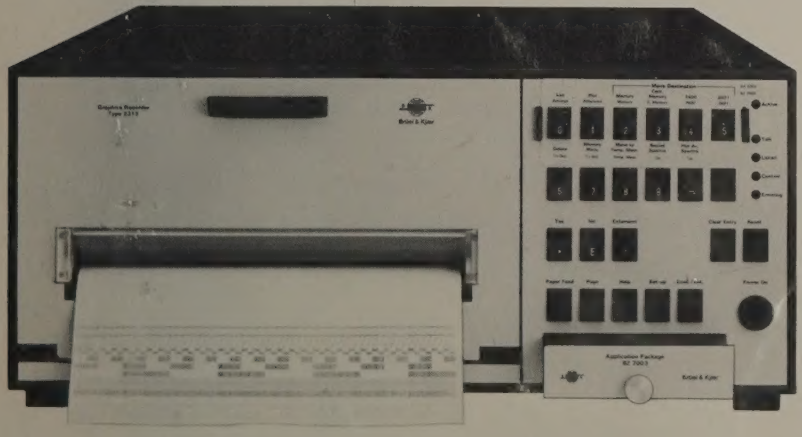
2313
BZ 7002
BZ 7003

Instruction Manual

Graphics Recorder Type 2313
plus Application Packages BZ 7002 and BZ 7003



A highly versatile alphanumeric printer and graphics recorder for use with digital measuring and analyzing equipment furnished with an IEC/IEEE interface. Together with Application Packages BZ 7002 and BZ 7003 it offers fast, fully annoted graphic plots of spectral and temporal data as displayed on the screens of the High Resolution Signal Analyzer Type 2033 and the Narrow Band Analyzer Type 2031. Also a variety of special tasks can be carried out, such as storage of measurement results, reformatting of data, plotting average spectra, plotting statistical data etc. The Packages will also produce 1/1 octave and 1/3 octave band data. For use with other B & K measuring and analyzing equipment, the 2313 may be fitted with a range of other Application Packages.

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GRAPHICS RECORDER TYPE 2313
PLUS
APPLICATION PACKAGES BZ 7002
AND BZ 7003

From serial no. 973241

October 1984

SAFETY CONSIDERATIONS

This apparatus has been designed and tested according to Class II of IEC Publication 348, Safety Requirements for Electronic Measuring Apparatus, and has been supplied in safe condition. The present Instruction Manual contains information and warnings which should be followed by the user to ensure safe operation and to retain the apparatus in safe condition. Special note should be made of the following:

APPLICATION OF POWER

Before each use of the apparatus, check that it is set to match the available mains voltage and that the correct fuse is installed.

SAFETY SYMBOLS

⚠ The apparatus will be marked with this symbol when it is important that the user refer to the associated warning statements given in the Instruction Manual.

⊥ Chassis terminal ⏚ Safety earth terminal ⚡ Hazardous voltage

WARNINGS

Whenever it is likely that the correct function or operating safety of the apparatus has been impaired, the apparatus must be made inoperative and be secured against unintended operation.

Any adjustment, maintenance and repair of the open apparatus must be avoided as far as possible and, if unavoidable, must be carried out only by trained service personnel.

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Graphics Recorder

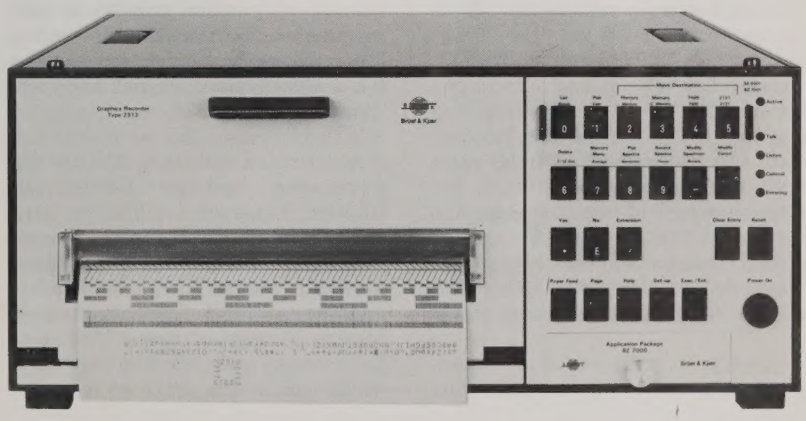
USES:

- Dot-matrix printer for plotting measured spectra presented on the display screen of B&K digital measuring or analyzing instrumentation, plus documenting front panel control settings etc.
- Versatile system controller for instruments equipped with IEC/IEEE digital interface bus
- Digital recorder for storage of spectra and front panel control setting data
- Reformatting of data for new types of measurement. Extends measurement capability of B&K equipment

FEATURES:

- High-resolution graphic and alphanumeric print out using fixed 512 point print head with 0,2 mm step paper feed
- Accepts 210 mm wide rolls of metallized paper. One 50 m roll equivalent to 160 A4 charts
- 96 standard and 32 special alphanumeric characters according to ISO 646 and 2022 standards
- Range of plug-in Application Packages available to suit the individual documentation and measurement needs of B&K measuring and analyzing equipment
- Built-in crystal controlled clock for print out of date and time together with measurement results
- Continuous and volatile memories for storage of measurement spectra
- Choice of Operating Set-Ups for specifying type of print out, memory allocation and measurement functions
- Simple, easy to follow pushkey operation, plus extensive "Help" file for step by step guidance of first time users

Introduction



The Graphics Recorder Type 2313 is a highly versatile alphanumeric and graphics printer for use with B&K digital measuring and analyzing instrumentation equipped with an IEC interface bus. Together with an appropriate Application Package it offers fast, fully annotated, graphic plots of frequency spectra, time functions etc., as presented on the display screen of B&K instruments. In addition, it may be employed as a conventional alphanumeric/graphics printer for documenting data transmitted by other digital equipment furnished with an IEC or IEEE interface.

Besides documentation of data, the 2313 is capable of performing a variety of other important tasks for which extra equipment would normally be required. Using its continuous and volatile memories, for example, several hundred complete measurement spectra can be recorded and stored for future print out or transmission to other equipment. Also, new types of measurement can be generated from stored and incoming data, plus use as a system controller is possible. Thus, whatever measuring instrumentation is employed, the 2313 opens up a whole new range of measurement possibilities and applications.

Description

Writing System

The writing system of the 2313 accepts 210 mm wide rolls of electrosensitive paper QP 4690. Two 50 m rolls are supplied with the Recorder, each providing the equivalent of 160 A4 (metric) size charts. The paper is of the readily available metallized type and produces clear well defined print that is not susceptible to fading as with chemically treated types.

When loaded in the 2313, the metallized surface of the paper contacts a fixed, single-element, print head. This is accessible via the paper outlet slot on the front panel to facilitate easy cleaning and to achieve a high resolution print has 512 individual electrodes. These are spaced at 0,4 mm intervals and span almost the complete paper width giving a maximum line width of 205 mm.

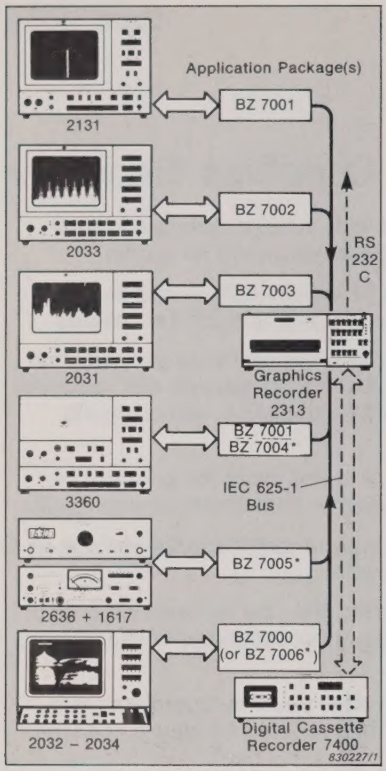


Fig. 1. Interchangeable Application Packages and Digital Frequency Analyzers for use with the 2313. Packages planned for release in the near future, are marked with an asterisk

For well formed characters and graphics, the paper is evenly accelerated and decelerated past the print head in 0,2 mm steps. Utilizing the plot mode for 512-point graphics, the maximum print rate is 46 lines per second. Due to the relatively smooth transition from one line to the next, relatively quiet operation is obtained.

In the print mode a total of 96 standard upper and lower case characters may be called on, plus 32 special characters. These are according to ISO 646 and 2022 standards respectively, and are based on a 6 by 8 point matrix. For enhancing different text four character sizes up to 12,8 mm may be chosen, which enable between 46 and 85 characters per line to be printed. In addition line spacings between 0,4 and 2,8 mm may be selected. The print rate depends on the size and number of characters printed and is between 3 and 9 lines per second.

If required text and graphics can be mixed by changing from the print to plot mode (or vice versa) at the start of a new line. Text and graphics may also be justified to the left or right margin of the paper and for filing in standard binders there is a "Page Feed" function for advancing the paper the remainder of one A4 or 11 inch chart.

Application Packages

As standard the Application Package BZ 7000 is included with the 2313. This plugs directly into a port on the front of the Recorder and facilitates use of the 2313 as a conventional alphanumeric/graphics printer as well as permits direct copying of spectra presented on the display screen of the B&K Dual Channel Signal Analyzers Types 2032 and 2034.

Also for use with the 2313 are the Application Packages BZ 7001 to BZ 7006. These are available as extra and especially convert the 2313 to suit the individual documentation needs of the B&K Digital Frequency Analyzers shown in Fig. 1. Furthermore they provide a range of special functions for storage and reformatting data, which enable new types of measurement to be made using the analysis equipment shown.

Note: For direct copying of measurements presented on the display screen of the B&K Dual Channel Signal Analyzers Types 2032 and 2034, any Application Package may be employed, including BZ 7000.

Documentation

Common to all Application Packages, except BZ 7000, are "List" and "Plot" functions. Both are selectable using the pushkeys of the Recorder and provide fully annotated, hard-copy documentation of measured frequency spectra and/or time domain functions in as little as 10 seconds. Examples of the two types of documentation are shown in Fig.2 and 3 respectively. Generally graphic plots of spectra resemble those presented on the display screen of B&K Digital Frequency Analyzers, except that they also have fully annotated measurement axes and include front panel control setting information plus the date and time of the readout.

If desired two separate spectra can be plotted simultaneously. Also, documentation may be modified to suit the specific signal analyzed. The latter is accomplished by selecting any one of three independent "Operating Set-ups" stored in the Recorder. These provide access to the different control functions of the particular package employed, permitting the user to change or select individual control parameters using the pushkeys of the Recorder. For example, different amplitude axes and offsets may be chosen or autoranged to correspond with the maximum signal level, only data within a user-defined frequency

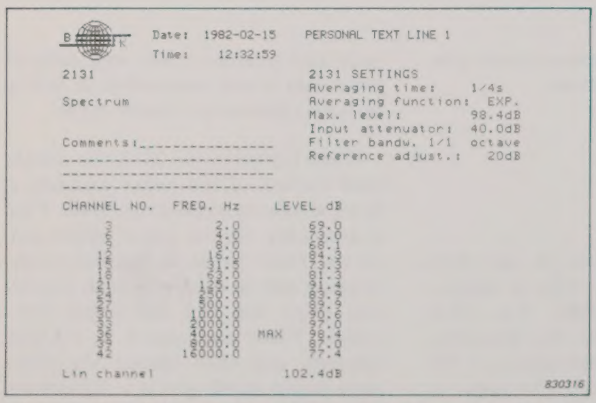


Fig.2. Typical listing of 1/1 octave analysis data, printed by the 2313 Graphics Recorder with Application Package BZ 7001

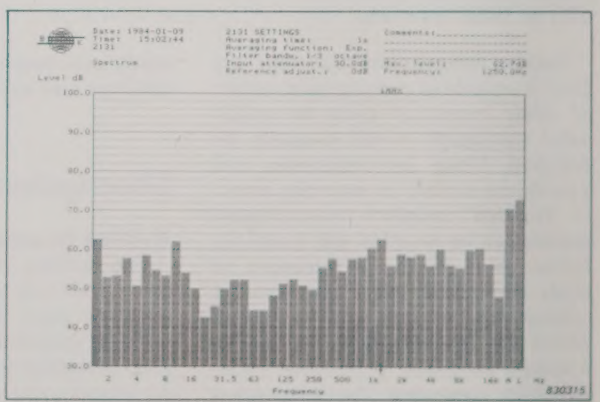


Fig. 3. Typical 1/3 octave analysis, printed by the 2313 Graphics Recorder with Application Package BZ 7001

range printed, and measurement axes graduated directly in dB and Hz or standard engineering units of Pa, ms^{-2}, mV etc.

Storage

The 2313 includes both continuous and volatile memories. These enable measured spectra and other data transmitted by particular equipment for which the Application Package is designed, to be individually filed during the course of measurements. Stored spectra may then be recalled at some other time for comparison with later incoming data or may be saved and reformatted for new types of measurement.

With the continuous memory approximately ten sets of complete spectra may be stored, whilst with the volatile memory storage of several hundred sets is possible (see Specifications). Also, a 100 step pushkey sequence can be entered, enabling a whole series of measurement, storage and documentation functions to be carried out completely automatically. For identification and quick location of data, a "Memory Menu" function can be activated which lists file numbers along with other main data concerning stored measurements.

To help safeguard stored data, special provision is made for securing consecutive memory files. Whereas the volatile memory is intended only for temporary storage, data stored in the continuous memory can be retained more-or-less indefinitely provided that the 2313 is subjected to regular use.

Measurements

An important feature of the 2313 is that it is capable of reformatting stored and incoming spectra, enabling new types of measurement to be documented, without having to use or especially program other equipment for the purpose.

The different types of measurement available cover production of sum, difference and average spectra, sound contour and 3D plots, 3-parameter (amplitude/frequency/time) mapping of single events etc. Furthermore, 1/1 or 1/3 octave spectra may be assembled from narrow-band data transmitted by Frequency Analyzers Types 2031 and 2033, or a 1/12 octave – 4 pass analysis carried out in conjunction with Frequency Analyzer Type 2131. See Fig.4 and Specifications.

Stored spectra may also be individually modified using the pushkeys of the Recorder. This is valuable for eliminating unwanted components, as well as for generating different reference spectra for comparison with incoming data.

Built-in Clock

All internal operating sequences are governed by a built-in clock generator. For data logging purposes there is a calendar function enabling both date and time to be automatically recorded at the head of each data file stored or documented with the Recorder. If need be the clock may be set to initiate a series of readouts at preselected intervals ranging from 1s to 24 hours, and/or start a control sequence after both a preset level and time have been exceeded. This is useful in airport noise surveys, machine surveillance for preventive maintenance etc.

Fig. 6. Alphanumeric characters available with the 2313 Graphics Recorder

Digital Interface and System Control

System control, plus digital input and output of measurement data, takes place via the IEC/IEEE Interface of the 2313. This enables a large number of instruments with compatible interface to be connected directly on-line with the Recorder. However, where more than digital input of data and manual operation of the measuring system is required, the 2313 must be fitted with an Application Package other than BZ 7000.

A notable feature of the Application Packages BZ 7001 to BZ 7006, is that they permit all information transfer over the IEC /IEEE bus of the measuring system to be governed by the

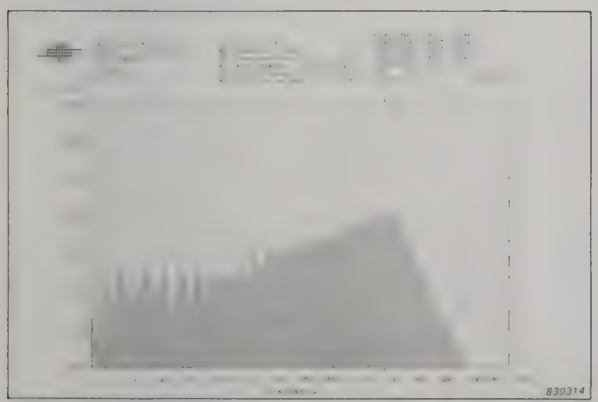


Fig. 4. Typical 1/12 octave – 4 pass analysis obtained using the 2313 Graphics Recorder with Application Package BZ 7001

Fig. 5. Typical graphics plot printed directly from the 2032 (or 2034) Signal Analyzer using the 2313 as a conventional graphics recorder with Application Package BZ 7000

2313. As a result the entire measurement system may be operated via the interface and front panel pushkeys of the Recorder. For instance, using a simple pushkey command, measurements displayed on the Frequency Analyzer may be sent to the Recorder for documentation or storage, or if required may be relayed to another device such as a 7400 Digital Cassette Recorder. Similarly, tape recorded data may be documented or stored in one of the continuous or volatile memories of the 2313, provided that this originates from the Frequency Analyzer for which the Application Package is designed.

Provided along side the IEC interface, is an RS 232C Serial Interface. This provides a secondary means of remote control of the 2313 and other equipment covered by its Application Package, plus permits entry of personal text in the documentation presented by the Recorder (see Fig. 4). Alternatively, personal text may be entered via the front panel pushkeys of the 2313.

Specifications 2313

WRITING SYSTEM:
Dot-matrix printing on Electrosensitive Paper QP 4690 using fixed 512-point print head with line width of 205 mm

Print Mode:
96 standard plus 32 special 6 by 8 matrix characters according to ISO 646 and 2022
Characters per Line: Selectable between 46 and 85
Character Height: Selectable 1,6; 3,2; 6,4 or 12,8 mm
Line Spacing: 0,4 to 2,8 mm
Print Rate: 3 full lines of 3,2 mm high characters per second corresponding to 250 characters per second

Graphics Mode:
Resolution: 25 dots/cm (63 dots/in)
Line Width: 204,4 mm
Line Spacing: 0,2 mm
Print Rate: 46 lines per second

PAPER DRIVE:
Step Length: 0,2 mm
Chart length: 297 mm A4 (metric) or 11 in (English) chart length
Page: Advances paper remainder of selected A4 or 11 in chart
Out of Paper: Warning printed plus paper drive automatically terminated at end of paper roll

IEC 625-1 STANDARD INTERFACE:
For system control plus digital input and output of data to be documented.

Connector: Standard 25-pin connector accepting Cable AO 0194 for connection to an IEC 625-1 interface system. Connection into an IEEE 488 interface system is made using Cable AO 0194 plus Adaptor AO 0195
Functions Implemented: Source Handshake (SH 1), Acceptor Handshake (AH 1), Talker (T 5), Listener (L 3), Service Request (SR 1), Remote Local (RL 1), Parallel Poll (PP 1), Device Clear (DC 1), Controller (C 1 to 5)
Transmission Speed: ~100 kbytes/s with direct memory access
System Control: Manual operation or use as system controller in accordance with Application Package
Job Specifications: Accepts job specification commands in IEC 625-2/IEEE Std. 728 format

RS-232C SERIAL INTERFACE:
For digital input of personal text
Connector: 25-pin (female) wired as DCE device
Transmission Speed: Selectable up to 9600 Baud

REMOTE CONTROL:
8-pin DIN socket providing make and break lines for control of external sound source, audible alarm, warning lamp etc. Maximum throughput 0,25 mA/200V

TEMPERATURE RANGE:
Operation: 5 to 40°C (41 to 104°F)
Storage: –25 to 70°C (–13 to 158°F)

MAX. HUMIDITY: 90% RH (non condensing at 30°C)

ELECTROMAGNETIC COMPATIBILITY:
Complies with Class B Device of the American FCC Rules

POWER REQUIREMENTS:
Complies with IEC 348 Safety Class II
Supply Voltage: 100; 115; 127; 200; 220; 240 V (50 to 60 Hz) ± 10% AC
Power Consumption: 60 VA nominal (160 VA max. instantaneous)

CABINET:
Supplied as Model A (light-weight metal cabinet) or Model C (as A but with flanges for standard 19 in rack)

DIMENSIONS:
Metal cabinet, excluding knobs and feet
Height: 177 mm (7,0 in)
Width: 430 mm (16,9 in)
Depth: 500 mm (19,7 in)

WEIGHT: 17 kg (37,5 lb)

ACCESSORIES INCLUDED:

1 × Mains Cable	AN 0020
2 × 50 m Roll of Recording Paper	QP 4690
1 × 8-pin DIN Plug	JP 0802
1 × 25-pin IEC 625-1 Bus Connector Kit	UA 0793
1 × 25-pin RS-232C Male Connector	JP 2500
1 × Application Package	BZ 7000*

ACCESSORIES AVAILABLE:

50 m Roll of Recording Paper	QP 4690
25-pin IEC 625-1 Interface Cable (2 m)	AO 0194
25-pin IEC (male, slide-lock) to IEC 625-1 Interface Cable (2 m)	AO 0184
25-pin Adaptor for Coupling into IEEE 488 Interface System	AO 0195

APPLICATION PACKAGES AVAILABLE:

BZ 7001 for Digital Frequency Analyzer Type 2131 and Sound Intensity Analyzer System Type 3360. Lists and plots 1/1 and 1/3 octave spectra. Stores 200 spectra plus 1 auto. control sequence. Genenerates "Lin" and "A"-weight channel – adds, subtracts and averages spectra – multiple plots of up to 40 spectra – 1/12 octave analyses – reverberation and decay measurements – 3-parameter (amplitude/frequency/time) maps. Clock, trigger and wait functions also included.

BZ 7002 and 7003 for Digital Frequency Analyzers Type 2033 and 2031 respectively. List and plot time functions plus narrow-band spectra. Stores approx. 60 spectra or 25×1k (2×10k) time functions, plus 1 auto. control sequence. Generate "Lin" and "A"-weight channel – 1/1 and 1/3 oct. spectra – distortion spectra – average spectrum and standard deviation. Also integration and differentation functions, as well as choice of autoscaling and engineering units.

BZ 7004 for Sound Intensity Analyzer System Type 3360.** Similar to BZ 7001, but with sound power measurements, sound contour and 3D plots (pressure and intensity) and source localization instead of 3-parameter mapping, average and multiple plots.

BZ 7005 for Measuring Amplifier Type 2636 plus Band Pass Filter Type 1617.** Similar to BZ 7001, but with L_{eq} measurements, autoranging of 2636 for extended dynamic range, plus remote control of 1617 and BT product

BZ 7006 for Dual Channel Signal Analyzers Types 2032 and 2034**

For more detailed information and specifications concerning the respective Application Packages, please consult your local B&K representative.

*BZ 7000 permits use as conventional alphanumeric printer, plus direct copying of measurements displayed on Analyzers Types 2032 and 2034. For graphic plots with other B&K Analyzers, the Application Packages listed under Accessories Available should be employed.

**Planned for release in the near future.

2. CONTROLS

2.1. FRONT PANEL

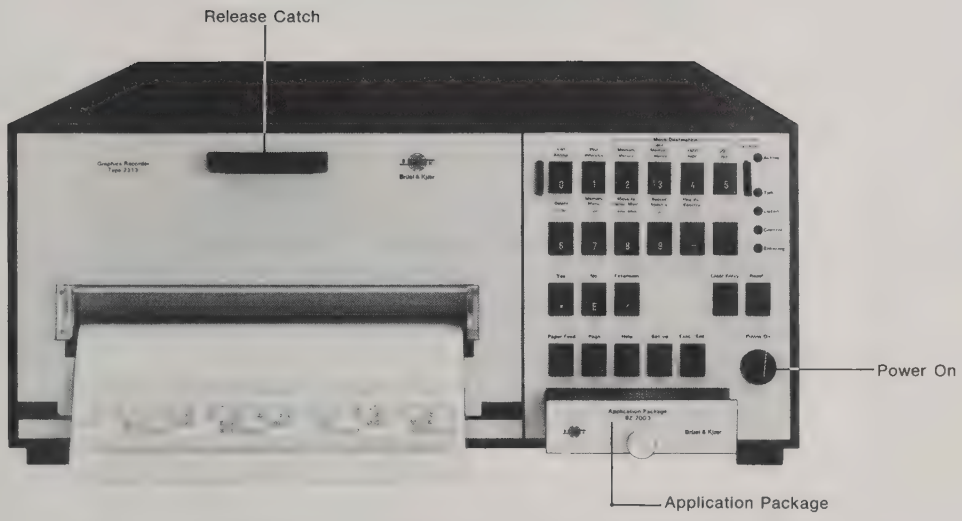


Fig. 2.1. Front panel of the Graphics Recorder Type 2313

Power On: On-Off switch for mains power. When set to **Power On**, either the **Active** or **Entering LED** at the top right hand corner of the front panel should light, accompanied by a print out of date and time.

Release Catch: Press down and pull to hinge forward the paper drive mechanism. See Section 3.7 for details on paper loading and cleaning of the print head.

Application Package: Plug-in module determining the operating functions available with the Recorder, including which measurement and analysis equipment the Recorder may be used with. For documentation, storage and reformatting of measurement data transmitted by the B&K High Resolution Signal Analyzer Type 2033, the Application Package BZ 7002 is employed. For the B & K Narrow Band Spectrum Analyzer Type 2031, the Application Package BZ 7003 is employed. See Section 3.6.

At the top right of the instrument are two rows of pushkeys. These are shown in Fig. 2.2 and are for keying in numerical data with the **Set-Up** mode of the Recorder, plus specifying memory and tape files to and from which measurement data is to be relayed for documentation and storage etc.

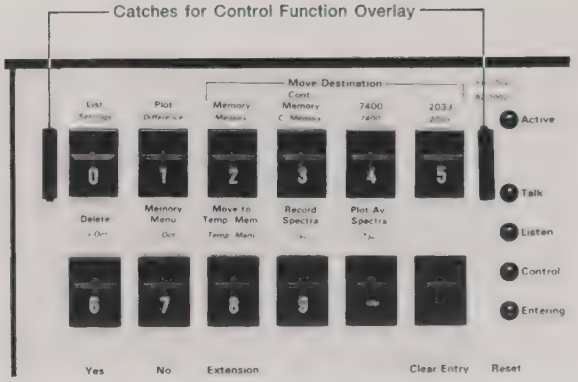


Fig. 2.2. Top two rows of front panel pushkeys on Graphics Recorder Type 2313. (Note that pushkey No. 5 is designated 2031 on the overlay employed with the B & K Narrow Band Analyzer Type 2031)

In addition the above pushkeys enable different functions and sub-functions to be chosen with the Recorder. These depend on the particular Application Package employed and are printed on a Control Function Overlay which is included with each package. The Overlay is a small oblong sheet of plastic and fastens between the catches on either side of the keys as indicated in Fig.2.2.

For operation with Application Package BZ 7002 the appropriate Control Function Overlay is SA 0302, for Application Package BZ 7003 the appropiate Control Function Overlay is SA 0303. Functions and subfunctions selectable using a single key stroke are indicated directly on the overlay and are headed by plain and cursive text respectively to help distinguish between them. Generally, functions are used to specify a destination (**Plot** spectra, for example) and may be selected when the **Active LED** beside the pushkeys is lit (see also Section 4.2), while sub-functions are used to specify a data source (**2033** or **2031** for example) and may be chosen following selection of a function when the **Entering LED** is lit.

Functions selectable using a single key stroke, are as follows:

List [0]: Generates a hard copy alphanumeric listing of measurement displayed on the 2033 (or 2031) or one already processed or stored using the 2313 plus BZ 7002 (or BZ 7003). See Section 4.2.1.

Plot [1]: Generates a hard copy fully annotated graphic plot of measurement displayed on the 2033 (or 2031) or one already processed or stored using the 2313 plus BZ 7002 (or BZ 7003). See Section 4.2.2.

Move to Memory [2]: Stores measurement from the 2033 (or 2031) (or one already processed or stored using the 2313) in a volatile memory file of the 2313. See Section 4.2.3.

Move to Cont. Memory [3]: Stores measurement from the 2033 (or 2031) (or one already processed or stored using the 2313) in a continuous memory file of the 2313. See Section 4.2.4.

Move to 7400 [4]: Stores measurement from the 2033 (or 2031) (or one already processed or stored using the 2313) in a tape file on the 7400 Digital Cassette Recorder. See Section 4.2.5.

Move to 2033 (or 2031) [5]: Sets the 2033 (or 2031) for display of measurement processed or stored using the 2313. See Section 4.2.6.

Delete [6]: Deletes measurement data stored in any one or group of non delete-secured memory files of the 2313, or all files of a non write protected tape cassette on the 7400. See Section 4.2.7.

Memory Menu [7]: Produces short form contents list of any one or group of memory files of the 2313, or of a tape file or files selected on the 7400. See Section 4.2.8.

Move to Temp. Mem. [8]: Explicitly stores measurement from the 2033 (or 2031) (or one already stored using the 2313) in temporary memory. Implicitly stores the result of the most recent execution. See Section 4.2.9.

Record Spectra [9]: Inputs a series of spectra from the 2033 (or 2031), storing them in consecutive volatile memory files in the 2313. May be used with the internal trigger or with a selected time interval between spectra. See Section 4.2.10.

Plot Av. Spectra [–]: Plots the average of a number of selected spectra stored in consecutive files in the 2313 volatile and continuous memories and on the 7400 tape cassette. See Section 4.2.11.

Sub-functions which may be selected using a single key stroke when the **Entering LED** is lit, are:

***Settings* [0]:** Stores all externally controllable pushkey settings of the 2033 (or 2031) and can be used to reinstate them. Storage can be in 2313 volatile and continuous memory files as well as 7400 tape cassette files. See Section 4.2.14.

***Difference* [1]:** Works out the difference between two specified spectra stored in 2313 volatile memory files. The result may be plotted, listed, displayed on the 2033 (or 2031) or stored in the 2313 temporary memory. See Section 4.2.15.

***Memory* [2]:** Selects the volatile memory as the data source for documenting, storing, deleting or modifying stored measurements depending on the particular destination or function selected.

***Cont. Memory* [3]:** Selects the continuous memory as the data source for documenting, storing, deleting or modifying stored measurements depending on the particular destination or function selected.

***7400* [4]:** Selects the 7400 Digital Cassette Recorder as the data source for documenting, storing or deleting tape recorded measurements provided that these have been previously processed using a BZ 7002 (or BZ 7003).

***2033 (or 2031)* [5]:** Selects the 2033 (or 2031) as the data source for documenting or storing a measurement originally displayed on the 2033 (or 2031)

***1/3 Octave* [6]:** Sub-function selecting 1/3 octave band analysis of a signal measured with the 2033 (or 2031). For stationary data a three-pass calculation is performed by the 2313. For transient data (2033 only) a scan average consisting of 37 overlapping Hanning time windows on a 10 K sample forms the basis of the 2313 calculation. See Section 4.2.16.

***1/1 Octave* [7]:** Sub-function selecting 1/1 octave band analysis of a signal measured with the 2033 (or 2031). Both stationary and transient (2033 only) spectra are calculated based on corresponding 1/3 octave band data. See Section 4.2.17.

***Temp. Mem.* [8]:** Selects the Temporary Memory as the data source for documenting, storing, deleting or modifying stored measurements depending on the particular destination or function selected. See Section 4.2.9.

***/jω* [9]:** Sub-function used for dividing each spectral line by its angular frequency. The result is a spectrum of a time function which is the time integration of the original time function. See Section 4.2.18.

****jω* [–]:** Sub-function used for multiplying each spectral line by its angular frequency. The result is a spectrum of a time function which is the time derivative of the original time function. See Section 4.2.19.

Due to limited space certain functions and sub-functions are not indicated on the Overlay. These are chosen using two or more separate key strokes as indicated below.

Probability Density [/] [1]: Calculates the probability density of the amplitude of a selectable number of time functions captured on the 2033 (or 2031). See Section 4.2.12.

Probability Distribution [/] [2]: Calculates the probability (cumulative) distribution of the amplitude of a selectable number of time functions captured on the 2033 (or 2031). See Section 4.2.13.

Personal Text [/] [100]: Permits entry of up to five lines of personal text in the control heading of measurements documented with the 2313. Text is stored in the continuous memory of the Recorder and is entered in ASCII coded form via the front panel pushkeys or over the IEC/IEEE or the RS 232C **Serial Interface** on the rear panel. See Section 4.2.20.

Execute 7400 Program [/] [101]: Stores and/or activates a soft-function in a special volatile memory file of the 2313. Soft-functions are available in Digital Tape Cassette form for replay with the 7400 and extend the choice of measurement functions available with the 2313. See Section 4.2.21.

Store 7400 Program [/] [102]: Initiates storage in a 7400 tape file of soft-function stored in the volatile memory of the 2313. Permits work-copy to be made of B&K Soft-Function Tape Cassettes. See Section 4.2.22.

Execute Sequence [/] [103]: Activates 200 step control sequence recorded using the **Enter Sequence** function of the 2313. Permits a whole series of measurement, storage and documentation functions to be carried out fully automatically. See Section 4.2.23.

Enter Sequence [/] [104]: Records a 200 step user-defined control sequence made up of different measurement, storage and documentation functions selectable with the front panel pushkeys. The sequence is stored in a specially allocated continuous memory file and is automatically deleted when **Enter Sequence** is selected for recording a new sequence. See Section 4.2.24.

Edit Sequence [/] [105]: Selects 200 step control sequence enabling it to be updated without first deleting the entire sequence. See Section 4.2.25.

Shift Function [/] [106]: Updates control parameters recorded with the **Enter Sequence** function. Permits automatic stepping of file no. etc. See Section 4.2.26.

Wait [/] [107]: Delays activation of one or more functions of a stored control sequence by a multiple of the entered time. Is used in conjunction with **Enter Sequence** function. See Section 4.2.27.

Wait Clock [/] [108]: Similar to **Wait** except that activation of a stored control function is delayed until the built-in clock corresponds with the entered time (Hour/Minute/Second). See Section 4.2.28.

Write 2033 (or 2031) Pushkey [/] [109]: Controls the setting of an externally controllable 2033 (or 2031) pushkey. Used in conjunction with **Enter Sequence.** See Section 4.2.29.

Relay On [/] [110]: Opens an external circuit via the **Remote Control** socket on the rear panel. Used for automatically switching on externally connected equipment in connection with measurements. See Section 4.2.30.

Relay Off [/] [111]: Closes an external circuit via the **Remote Control** socket on the rear panel. Used for automatically switching of externally connected equipment in connection with measurements. See Section 4.2.31.

Record Single [/] [112]: Has the effect of pressing RECORD "Single" on the 2033 (or 2031). In this way a full time function record is ensured. See Section 4.2.32.

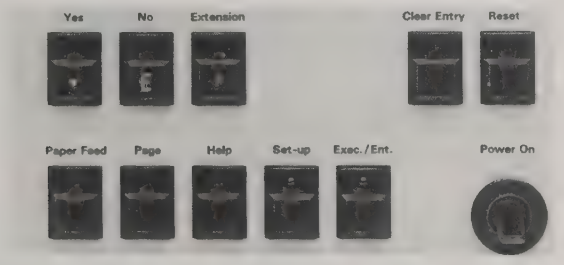


Fig. 2.3. Bottom two rows of pushkeys on the Graphics Recorder Type 2313

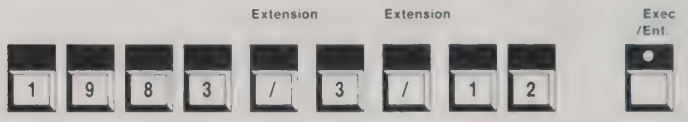
In Fig. 2.3 are shown the remaining pushkeys of the Recorder, the main functions of which are described below and not related to the particular Application Package employed.

Yes [.]
and
No [E]:

For user communication and setting up of parameters with the Set-Up and Clock mode of the Recorder. The decimal point **[.]** and exponential **[E]** are secondary functions and are used when entering numerical data.

Extension [/]:

Extends the choice of functions available with the top two rows of pushkeys. Is also used to separate functions, parameters and numerical data etc., in order that they may be entered as a single string instead of individually. e.g.



Clear Entry:

Deletes last command or numerical data entered using top two rows of pushkeys. Permits false entry to be corrected prior to activating **Exec./Ent.**

Reset:

Terminates selected function returning the Recorder to normal standby status. See Section 3.8.1 for other types of reset available.

Paper Feed:

Advances paper as long as pushkey is held depressed. If **Exec./Ent.** is activated while **Paper Feed** is held depressed an automatic self-test is initiated. See Section 3.8.2.

Page:

Advances paper the remainder of one full Metric or English page depending on the setting of the **Address Switch** on the rear panel.

Help:

Activates print-out of short-form data and instructions to aid entry of commands and other data via the front panel pushkeys.

Set-Up:

On-Off key, which initates the setting up procedure for the different forms of read-out. The built-in LED of the key lights when the Set-Up procedure is activated.

Exec./Ent:

Executes a command or terminates entry of data via the front panel pushkeys. The built-in LED of the key lights when **Exec./Ent.** is activated and command execution is in progress. Pressing **Exec./Ent.** immediately after a function has been executed will repeat the function and where pertinent will automatically update memory and tape file parameters etc. See Section 4.2.

Active LED:

Lights when the Recorder is used as a system controller (e.g. **Address Switch** set to "System Controller Active"), and data is not being entered. Indicates that the Recorder is ready to accept a function via the front panel pushkeys of the instrument.

Talk LED:

Lights when the Recorder is sending data over the IEC Interface.

Listen LED:

Lights when the Recorder is receiving data over the IEC Interface.

Control LED:

Lights when the Recorder is sending IEC control commands over the IEC Interface.

Entering LED: Lights when the Recorder is ready to accept numerical data entered via the front panel pushkeys of the instrument or sent over the IEC Interface.

2.2. REAR PANEL

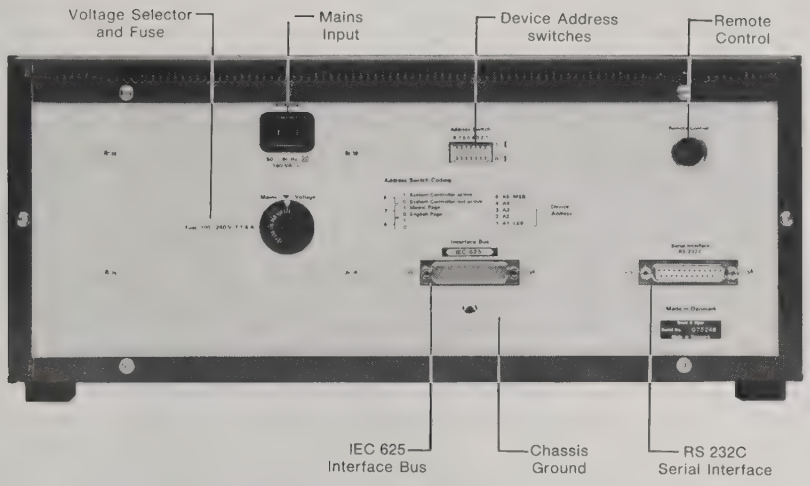


Fig. 2.4. Rear panel of the Graphics Recorder Type 2313

Address Switch: A set of eight miniature two-position rocker switches for manual selection of device address number with the digital interface bus of the 2313, plus selection of "System controller Active" or "Not Active" and "Metric" or "English" page length. On delivery the **Address Switch** numbers A5 to A1 are set to "00001" (ie., device address number 1). See Sections 4.1. and 6.3.

IEC 625 Interface Bus: 25-pin connector conforming to IEC 625-1. Is for digital input and output of measurement data plus remote control of the measurement and recording system via a IEC 625-1 or IEEE std. 488 digital interface bus. See introduction of Chapter 6 for appropriate interface cable.

RS 232C Serial Interface: 25-pin connector for digital input of personal text plus remote setting of the front panel pushkeys and operating Set-Ups of the Recorder via the keyboard of an RS 232C terminal. See Chapter 7.

Remote Control: 8-pin socket accepting the standard DIN plug (B&K no. JP 0802) with screw lock provided. Permits remote switching of external equipment and machinery. The relay has a maximum contact rating of 0,25 A, 200 V, and 3 W respectively, and is connected with the **Remote Control** socket as indicated in Fig 2.5.

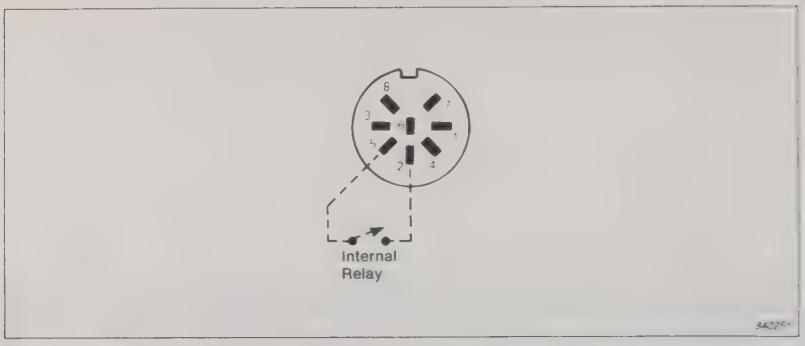


Fig. 2.5. Remote Control Socket on rear panel of Graphics Recorder Type 2313

Voltage Selector and Fuse:

Voltage selector for operation from a 100; 115; 127; 200; 220 or 240 V AC mains supply. The selector also contains a slow blow mains fuse. To select the appropriate voltage setting and fit the correct fuse, see Section 3.3.

Mains Input:

2-pin socket accepting the Power Cable AN 0020 provided for connection of an AC mains supply. Before connecting a supply, the mains voltage setting and fuse checks given in Section 3.3 should be carried out to ensure safe operation of the instrument.

3. PRELIMINARY

3.1. ENVIRONMENT AND HANDLING

The Graphics Recorder Type 2313 is designed for indoor use at temperatures from +5 to +40°C (+41 to +104°F) and humidities up to 90% RH (non-condensing) at 30°C. For safe operation avoid use in volatile environments and before each use of the instrument check that it is set to match the available supply voltage as described in Section 3.3.

To ensure reliable operation, it is important that the following be observed:

- When first using the 2313 keep it powered for approximately 14 hours to prevent loss of data stored in its continuous memory.
- If the 2313 is not to be used for 4 weeks or more, disconnect the internal Ni-Cd battery used to power its continuous memory (see Section 3.4).
- For optimal reproduction of printed data regularly clean the print head of the 2313 as described in Section 3.7. Avoid use of chemical cleaning agents and sharp tools, as these can damage the print head.

3.2. BENCH AND RACK MOUNTING

The 2313 may be used free-standing on its four plastic feet or, with the addition of the Flanges KS 0024 available, may be mounted in a 19 inch instrumentation rack. The flanges fasten via two screw holes at the front of the instrument side panels. These are accessible on easing back the bottom panel fastened by two screws on the rear of the instrument, and withdrawing the plastic corner plus grooved plastic strips at the front of the side panels. Before releasing the bottom panel ensure that 2313 is disconnected from the mains supply.

3.3. CONNECTION OF MAINS SUPPLY

Before connecting a mains supply, the following mains voltage setting and fuse checks should be carried out to ensure safe operation of the instrument.

Mains Voltage Setting

The 2313 may be powered from 100, 115, 127, 200, 220 and 240 V ±10% (50 to 60 Hz) single phase AC mains lines. To select the correct mains voltage setting, use a small screwdriver to push in and release the fuse holder at the centre of the **Mains Voltage Selector** on the rear panel. Pull the fuse holder straight out and using a small coin or wide-blade screwdriver turn the selector disc so that the appropriate voltage setting lines up with the black arrow printed on the panel.

Fuse Rating

To check or replace the mains fuse, release and withdraw the fuse holder at the centre of the **Voltage Selector**. For operation from 100 to 240 V AC supplies the fuse should be a 1,6 A slow blow (B & K no. VF 0007). Make sure that only fuses with the required rated current and of the specified type are used for replacement. The use of mended fuses and the short circuiting of fuse holders should be avoided.

Supply Connections

Once the mains voltage setting and fuse have been checked, the mains supply may be connected to the **Mains Input** socket of the 2313 using the Power Cable AN 0020 supplied. The 2313 has a high standard of safety insulation in accordance with safety class II of IEC 348 and therefore its chassis need not be connected to mains ground.

3.4. CONNECTION OF CONTINUOUS MEMORY SUPPLY

Both the continuous memory and built-in clock of the 2313 are powered by a rechargeable Ni-Cd battery. As standard this is supplied already wired in the 2313, but to avoid unnecessary power drain during storage and shipment is internally disconnected from the instrument.

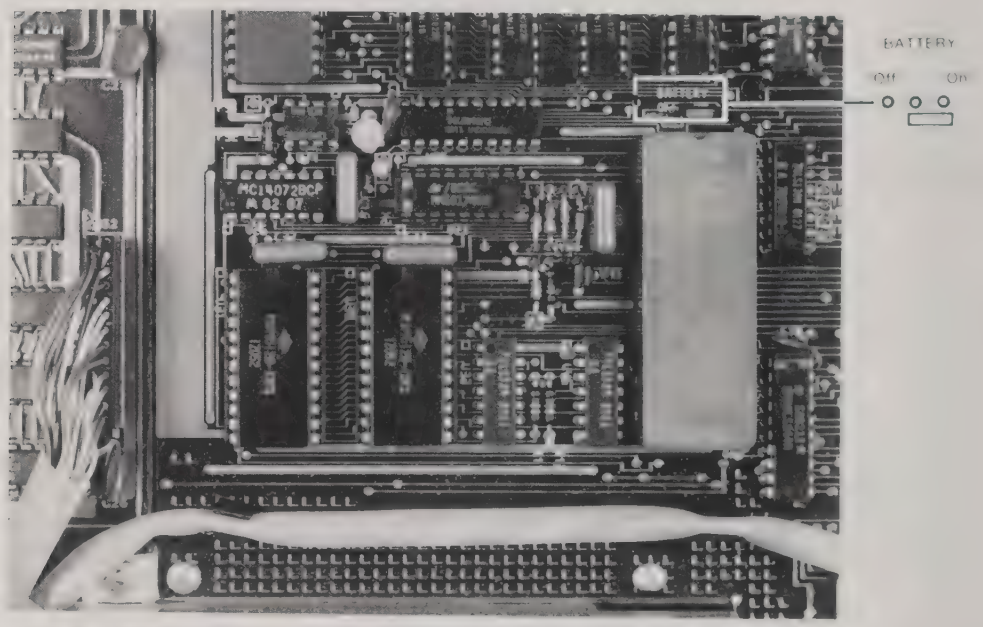


Fig. 3.1. Contact clip for connecting and disconnecting the internal Ni-Cd battery used for powering the continuous memory and clock of the 2313

To connect the Ni-Cd battery, disconnect the mains supply from the 2313 and remove its top panel which is fastened by two screws on the rear of the cabinet. The battery is located on the main circuit board on the base of the instrument. It may be connected by sliding off the contact clip from the group of three pins shown in Fig. 3.1 and using it to connect the centre pin and pin marked "On".

For recharging the Ni-Cd battery, the 2313 has its own charging circuit built-in. This is operative as long as the 2313 is powered from a mains supply and keeps the continuous memory powered more or less indefinitely provided that the 2313 is subjected to approximately 30 minutes use each day, 3,5 hours use each week or 14 hours use every 4 weeks. However, when using the 2313 for the first time it should be kept powered for at least 14 hours to ensure that the battery attains full charge capacity.

WARNING! To prevent damage to the battery ensure that it is regularly charged. If the 2313 is not to be used for more than 4 weeks, recharge the battery for approximately 14 hours and disconnect it as described above.

3.5. GROUNDING CONSIDERATIONS

Indiscriminate grounding of instruments can introduce ground loop interference. To prevent this influencing the measuring and analyzing instruments with which the 2313 is used it is important that the signal and digital ground lines of the instruments are grounded at one point only in the measurement system. To do this without prejudicing the operating safety of the instruments, proceed as follows:

1. Connect the signal ground lines of all instruments together. This is done automatically through the screens of the input and output cables used to interconnect the instruments.

2. Where the same instruments are interconnected by more than one signal cable or combination of signal and remote control cables each containing a signal ground connection, keep the cables short and close together or disconnect the signal ground line of all but one of them.

3. Where instruments are interconnected by a digital interface cable containing a chassis ground connection, check that one and only one of these instruments has its signal ground or digital ground connected to chassis (and chassis connected to mains ground if equipped with a mains connector having a protective earth - chassis contact).

4. Where the measurement arrangement is used free-standing without the instrument cabinets touching, check that each of the other instruments in the measurement arrangement has its chassis connected to a) mains ground only or b) signal ground or digital ground only. With instruments equipped with a mains connector having a protective earth-chassis contact, a) is to be preferred.

5. Where the measurement arrangement is mounted in an instrumentation rack, ensure that one and only one of the instruments has its signal ground or digital ground connected to chassis (and chassis connected to mains ground if equipped with a mains connector having a protective earth - chassis contact). If more than one of the instruments has a permanent signal ground - chassis connection, then isolate the cabinets of these instruments from the rack.

6. Finally, where the signal ground line is connected to mains ground via the mains connector of one of the instruments, isolate the housing of the measurement transducer from grounded measurement sources.

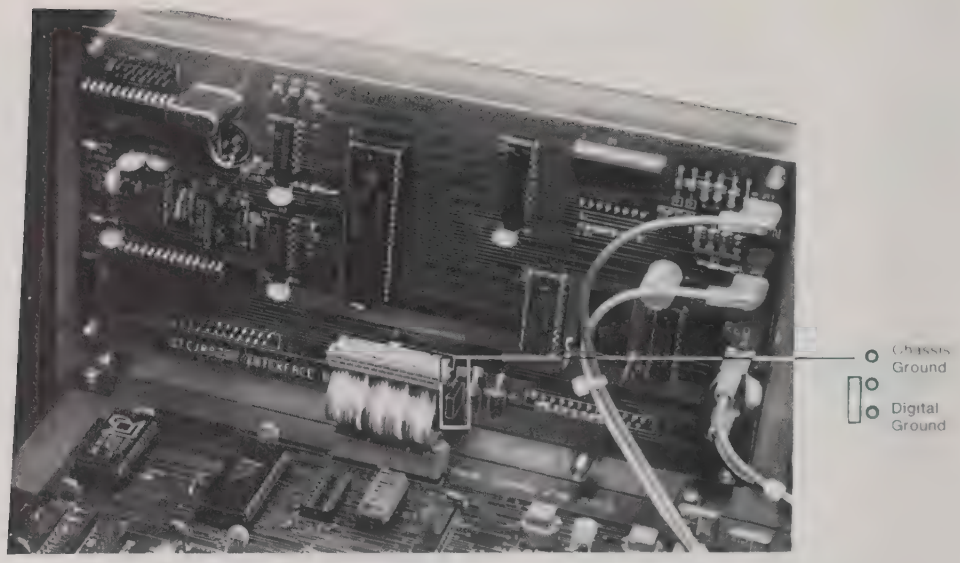


Fig. 3.2. The digital and chassis ground contacts of the 2313

As standard the 2313 is delivered with its digital ground connected to chassis, which is that normally required for operation in most instrument set-ups. However, where the above grounding requirements dictate otherwise, they may be disconnected from one another by carefully easing off the contact clip from the interface board contacts shown in Fig. 3.2 and using it to connect the top and middle contacts indicated. The interface board is mounted on the rear panel and is accessible on sliding off the top panel which is fastened by two screws at the back of the instrument. Before removing the top panel ensure that 2313 is disconnected from the mains supply.

WARNING! The 2313 is designed to be operated with its digital ground and chassis at zero earth potential. Never let the signal ground terminals, socket screens or chassis float at other than approximately zero earth potential, as this will impair the operating safety of the apparatus and may damage it.

3.6. INSTALLATION OF APPLICATION PACKAGE

Application Packages BZ 7002 and BZ 7003 especially convert the 2313 for documenting, storage and reformatting measurement data transmitted by the B&K High Resolution Signal Analyzer Type 2033 and the B&K Narrow Band Spectrum Analyzer Type 2031 respectively. They also facilitate use of a Digital Cassette Recorder Type 7400, thus enabling tape recorded measurements to be handled, provided that these originate from either the 2033 or 2031. For operation with other digital equipment, one of the other Application Packages available for the 2313 should be employed. See Chapter 1.

Before replacing an Application Package with either a BZ 7002 or a BZ 7003, it is advisable to check the contents of the continuous and volatile memories of the 2313 using the **Memory Menu** function (see section 4.2.8). If important data from previous measurements is present, then it should be recorded on tape as described in Section 4.2.5. This is necessary as stored data will be automatically deleted when a new Application Package is fitted.

Having carried out the above check, the Application Package may be replaced by either a BZ 7002 or a BZ 7003. To do this set the **Power On** switch of the 2313 to "Off",

unscrew the captive fastening on the front of the Package and use this to pull the Package out of the Recorder. The BZ 7002 or BZ 7003 may then be inserted and the corresponding Control Function Overlay (SA 0302 for the BZ 7002 and SA 0303 for the BZ 7003) clipped over the top row of pushkeys on the front panel as indicated in Fig. 3.3. For protection from dust and other foreign matter never leave the Recorder without a Package fitted and store Packages not in use in their mahogany case together with their Control Function Overlay.

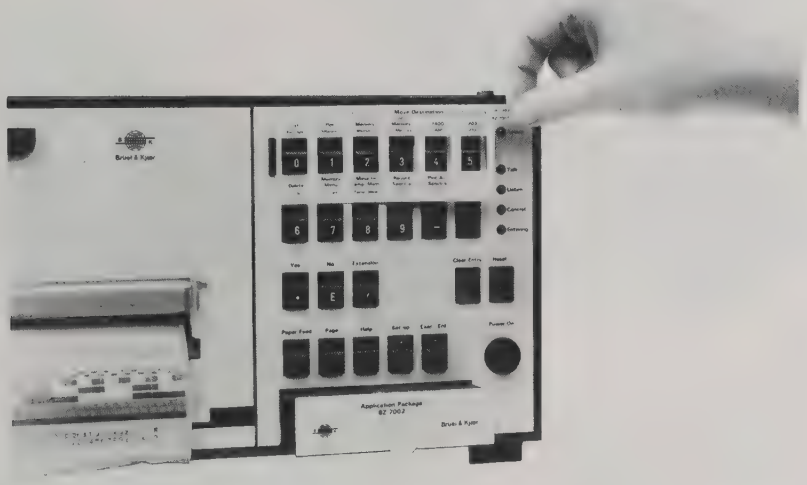


Fig. 3.3. Fitting of Application Package and Control Function Overlay

3.7. PAPER LOADING AND CLEANING OF THE PRINT HEAD AND ROLLERS

To load the 2313 with a fresh roll of Paper QP 4690, proceed as follows:

1. Press down the **Release Catch** on the front panel and pull forward the paper drive frame as shown in Fig. 3.4.

2. Lower the **Release Arm** on the left of the drive frame and lift out the paper spindle together with the remainder of the old paper roll if one is fitted.

3. Wipe a soft lint-free cloth along the rear of the print head to remove traces of print dust which may have accummulated during previous use. See Fig. 3.5.

4. Slide a fresh roll of Paper QP 4690 onto the paper spindle and hold it just in front of the drive frame as shown in Fig. 3.4.

5. Push each end of the paper spindle into the empty **Take-Up Slots** on either side of the drive frame and check that the spindle clips fast on the ball-catches in the slots.

6. Remove the adhesive label and pull out approximately 30 cm (12 in) of paper from the roll.

7. Carefully feed the free end of the paper between the guide and drive spindles until it protrudes from the opening on the front panel of the drive frame.

8. Lightly pull the free end of the paper to take up any slackness and raise the **Release Arm** on the left of the drive frame to lock the pressure spindle.

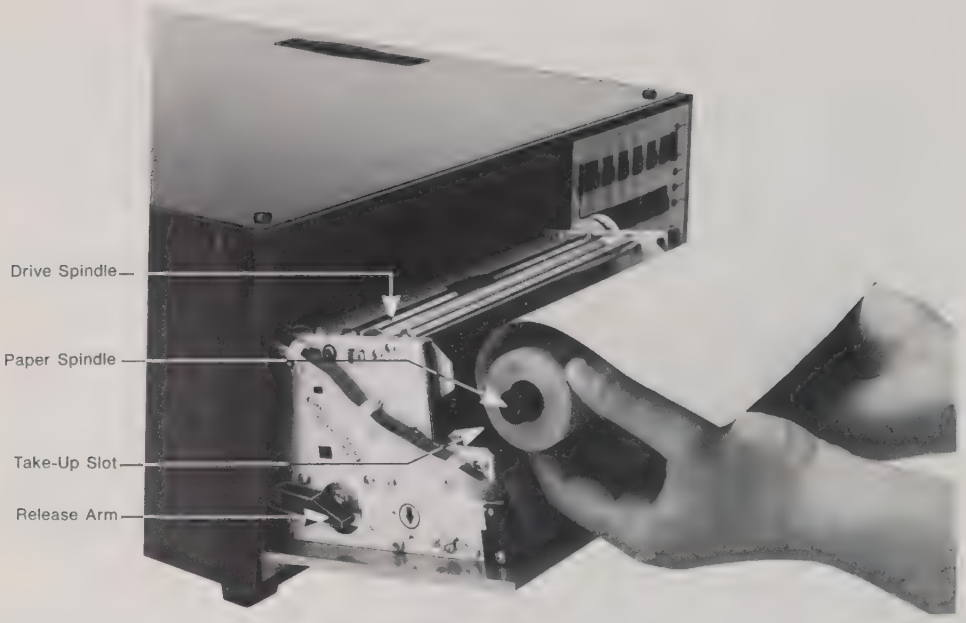


Fig. 3.4. The Paper Drive Frame of the 2313

9. Hinge up the front of the drive frame so that it is flush with the front panel of the 2313 and push the **Release Catch** up to lock.

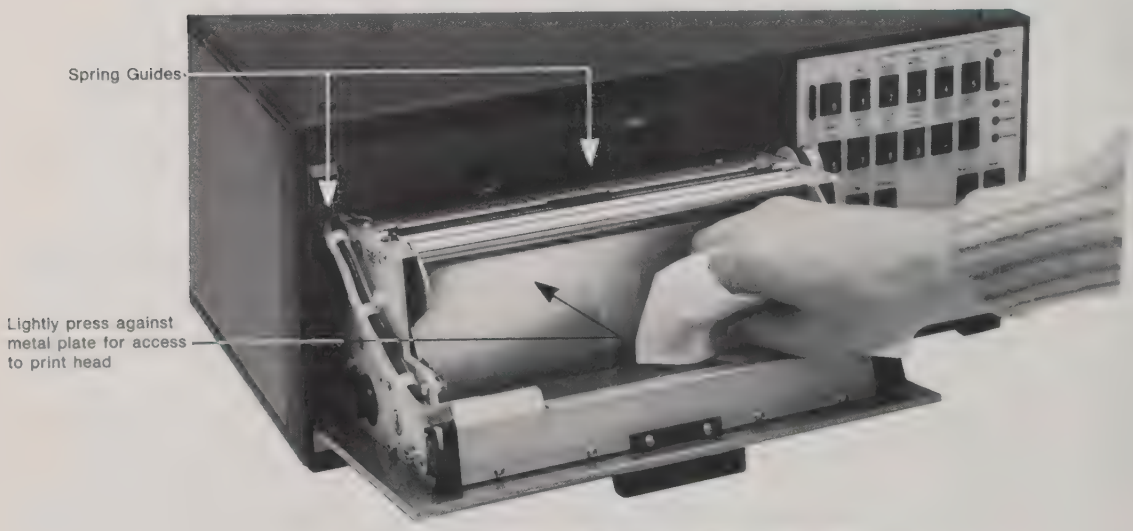


Fig. 3.5. Cleaning the Print Head of the 2313

After loading a fresh roll of recording paper it is recommended that the Self-Test mode of the 2313 be activated as outlined in Section 3.8.2. Provided that the Recorder is functioning correctly then it should generate an exact replica of the test print shown in Fig.3.6.

Should the test print show signs of uneven printing or lack contrast, then it is likely that there are more firmly embedded traces of print dust on the print head. These may be

removed by lightly brushing with a soft bristled tooth brush and wiping with a lint-free cloth as shown in Fig. 3.5. For access to the print head carry out items 1 and 2 above and gently press the metal plate at the rear of the writing system to move it 1 or 2 mm away from the head.

The two metal spindles which have contact with the metallised side of the paper act as common current contacts. If the spindles become covered by a grey deposit, bad contact may occur which will reduce the overall printing contrast. The deposit may be removed using ordinary metal polishing paste or liquid.

If the paper slips during printout then there is insufficient friction between the paper and the rubber roller. To restore normal friction remove paper dust from the rubber roller using a soft cloth lightly soaked in alcohol.

If the paper starts to run slightly out of alignment, causing it curl or fold at either its left or right-hand edges, then it is possible that the spring guides at the rear of the writing system compartment require attention (see Fig. 3.5). Normally this is not a frequent occurence and can easily be rectified by gripping the bottom of the guide nearest the faulty edge of the paper and bending it out slightly so that it makes proper contact with the paper when the writing system is folded back into the Recorder.

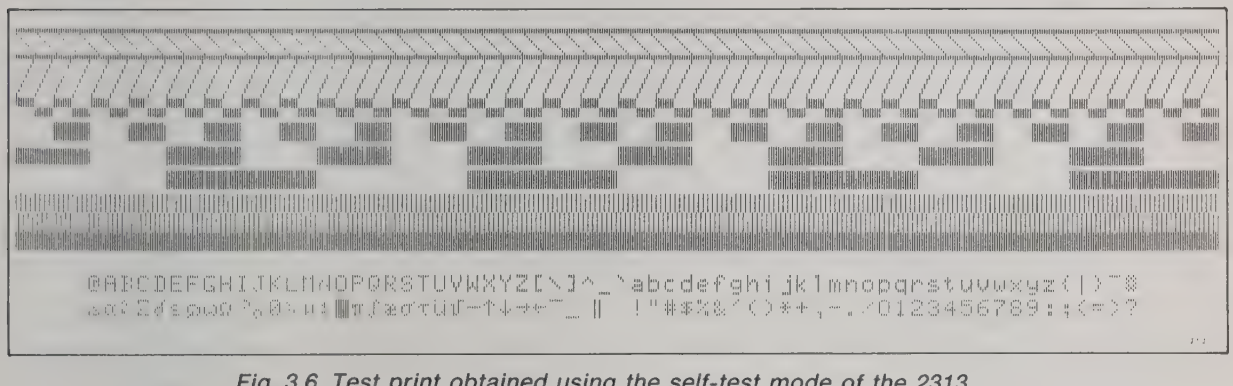


Fig. 3.6. Test print obtained using the self-test mode of the 2313

3.8. USE OF RESET AND AUTOMATIC SELF–TEST

3.8.1. Reset

The **Reset** pushkey is useful for quickly terminating execution of a control function following choice of an incorrect function or one that is not self terminating. In such circumstances, pressing the **Reset** key will return the 2313 to normal standby status where selection of a new function is possible.

Another use of the **Reset** pushkey is in ensuring that the 2313 always selects the appropriate control mode following alteration of its **Address Switch**. In addition, it is capable of restoring normal operation of the Recorder when this has been blocked by a minor malfunction or mains interference. However, whether this use of the **Reset** key is successful or not largely depends on type of disturbance. If not successful, normal operation can usually be restored by selecting **Power Off** for a couple of seconds and then selecting **Power On**. This has the effect of performing a *power on reset*, which returns the 2313 to its initial power on status, deleting measurement data stored in its volatile memory. If desired a *power on reset* can be performed as part of Self-Test, which is described in Section 3.8.2.

A further means of restoring normal operation after a minor malfunction is by pressing the **Paper Feed** pushkey and whilst keeping it pressed, momentarily pressing **Reset**. This performs a *hard reset* which resets the entire instrument including its built-in clock, plus deletes all measurement data in its volatile and continuous memories. A *hard reset* should therefore only be performed after having tried the other methods of reset described.

If the 2313 fails to respond correctly even after a *hard reset*, then it is likely that a more serious fault has occurred. To check the Recorder plus the Application Package the Self-Test mode discussed in Section 3.8.2 can be employed.

3.8.2. Automatic Self-Test

For checking the correct function of the 2313, it is equipped with a Self-Test mode. This may be activated in two ways, the simplest of which is by pressing the extreme right-hand key in the second from top row of pushkeys and while keeping it depressed, momentarily pressing **Reset**. The 2313 then starts the test cycle described below and on completion of the tests performs a *power on reset* which returns the 2313 to normal power on status plus deletes measurement data stored in the volatile memory of the instrument.

Where it is important that stored data not be deleted, Self-Test can be activated to provide a print out of a test chart instead. This is provided at the start of the test cycle and is useful in checking the writing system of the Recorder (see Section 3.7). It is chosen by pressing the **Paper Feed** pushkey and while keeping it depressed, pressing **Exec./Ent.** However, first it is important that the "System Controller Active" mode be selected by setting **Address Switch** number 8 on the rear panel to "1" (see Fig. 4.2.) and pressing the **Reset** pushkey.

Having carried out the above, the Self-Test mode lights all five control LEDs in the top right corner of the front panel and proceeds to check the electronic circuitry of the Recorder and Application Package. On satisfactorily completing each check it automatically extinguishes the relevant control LED. It then continues with the next check until finally only the **Active LED** remains lit, indicating that the test sequence is completed and that the Recorder has returned to normal operating status.

Provided that the 2313 is functioning correctly, the entire test sequence takes approximately 75 seconds to carry out. If, however, a fault is detected then the test sequence will be permanently interrupted. At the same time the relevant control LED for the test plus those yet to be completed will flash, warning that a fault is present.

Where Self-Test is automatically interrupted and only the **Entering** and **Control LED**s remain extinguished, then it is likely that only the Application Package is at fault. To check whether this is the case, disconnect mains power and reactivate Self-Test with another Package fitted. For repair of the Recorder and/or Application Package, please contact your local B&K service representative. Under no circumstances should repair be attempted by persons not qualified in the service of electronic equipment.

3.9. SET-UP PROCEDURE

Following installation of an Application Package BZ 7002 or BZ 7003 and a roll of Recording Paper QP 4690, one may proceed directly with operation as described in Chapter 4. However, to make full use of the complete range of documentation, storage and measurement functions available with the Application Package, plus ensure correct read

out of date, time etc., it is necessary to develop a basic understanding of the **Set-Up** mode of the Recorder.

The **Set-Up** mode is selected using the key of the same name in the bottom row of pushkeys of the Recorder. As indicated in Fig.3.7 it provides access to the "Select Set-Up", "Set Function", "Set Parameter" and "Set Clock" levels of the Recorder, the use of which are briefly discussed here and in more detail in the following Sections.

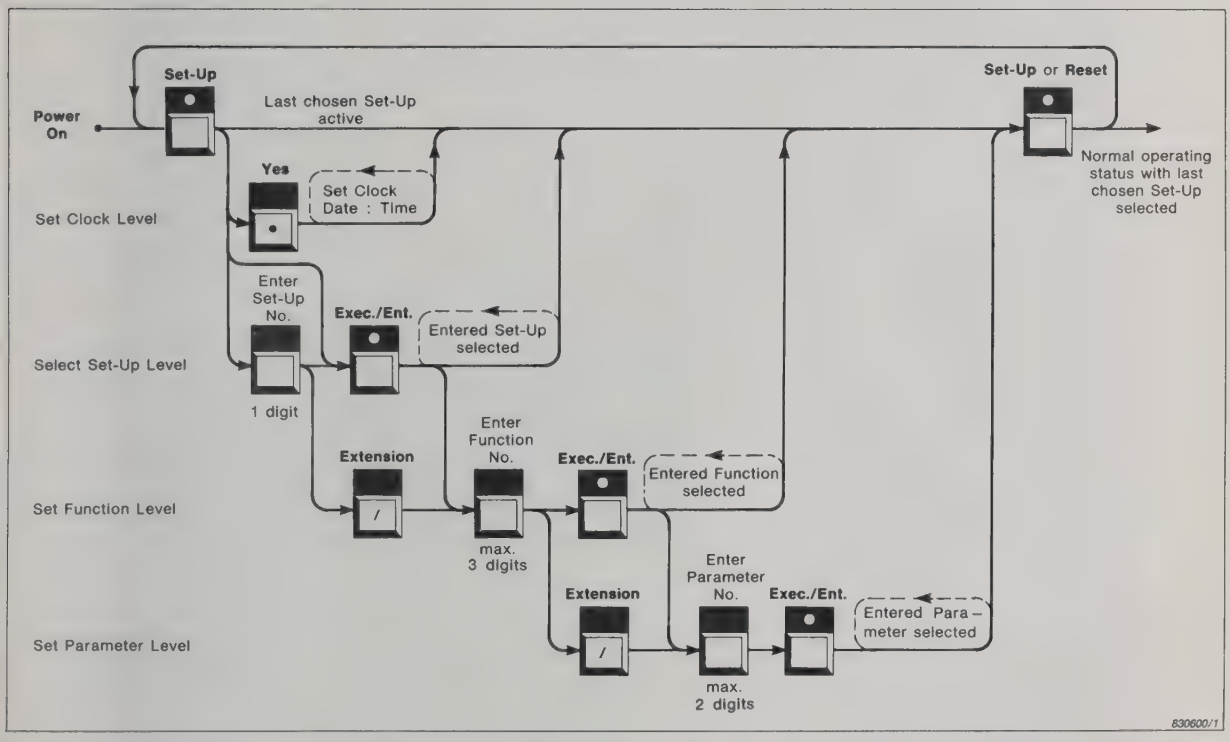


*Fig. 3.7. Simplified flow-diagram for selection of set clock level, as well as individual Operating Set-Ups, functions and parameters with the **Set-Up** mode of the 2313*

With the "Select Set-Up" level any one of four Operating Set-Ups numbered from 0 to 3 may be chosen. Each Set-Up is furnished with functions and parameters, which for the Application Packages BZ 7002 and BZ 7003 are listed in Fig 3.8 and Fig. 3.9 respectively and are individually numbered to permit access via the front panel pushkeys of the Recorder. Whereas the parameter values and units of Set-Up No: 0 are fixed, those of Set-Ups No: 1 to 3 may be changed by the user to suit individual application requirements. The range of values and units to which the different parameters may be set depends on the particular control function to which they belong and are as specified in Sections 4.2.1 to 4.2.35 respectively. It is very helpful to have a complete function list on hand when getting to know the instrument.

Function list
For a complete list of functions available in the Application Package press **[Clear Entry-][Help]**

For a complete list of the available Set-Up parameters for all Functions press **[Set-Up][Exec.][Yes]**. Come out of Set-Up mode again by pressing **[Set-Up]**.

SELECTED SETUP NO.: 0

	FUNCTION		PARAMETER		VALUE	UNIT
	0 List	1	Personal text	:	NO	
	0 List	2	List from	:	0.0000E+00	s
	0 List	3	List to	:	200.0000E-03	s
	0 List	4	List from	:	50.0000E+00	Hz
	0 List	5	List to	:	20.0000E+03	Hz
	0 List	6	Sampling reduction	:	5	
	1 Plot	1	Personal text	:	NO	
	1 Plot	2	Scaling	:	2033 scale	
	1 Plot	3	Log. full scale level	:	110.0000E+00	dB
	1 Plot	4	Lin. full scale level	:	1.0000E+00	
	2 Memory	1	Store-secured	:	-1 -1	
	3 Contin. memory	1	Store-secured	:	-1 -1	
	5 2033	1	Move stored settings	:	YES	
	6 Delete	1	Memory secured	:	-1 -1	
	6 Delete	2	Contin. memory secured	:	-1 -1	
	9 Record spectra	1	Control	:	Time	
	9 Record spectra	2	Time between spectra	:	1	s
	10 Plot av. spectra	1	Extra curves	:	None	
	10 Plot av. spectra	2	Averaging	:	Arithmetical	
(/ 1)	11 Prob. density	1	Amplitude classes	:	100	
(/ 1)	11 Prob. density	2	Suppress σ - marks	:	NO	
(/ 1)	11 Prob. density	3	Number of records	:	1	
(/ 2)	12 Prob. distribution	1	Amplitude classes	:	100	
(/ 2)	12 Prob. distribution	2	Suppress σ - marks	:	NO	
(/ 2)	12 Prob. distribution	3	Number of records	:	1	
(/100)	110 Personal text	1	Enable line 0	:	NO	
(/100)	110 Personal text	2	Enable line 1	:	NO	
(/100)	110 Personal text	3	Enable line 2	:	NO	
(/100)	110 Personal text	4	Enable line 3	:	NO	
(/100)	110 Personal text	5	Enable line 4	:	NO	

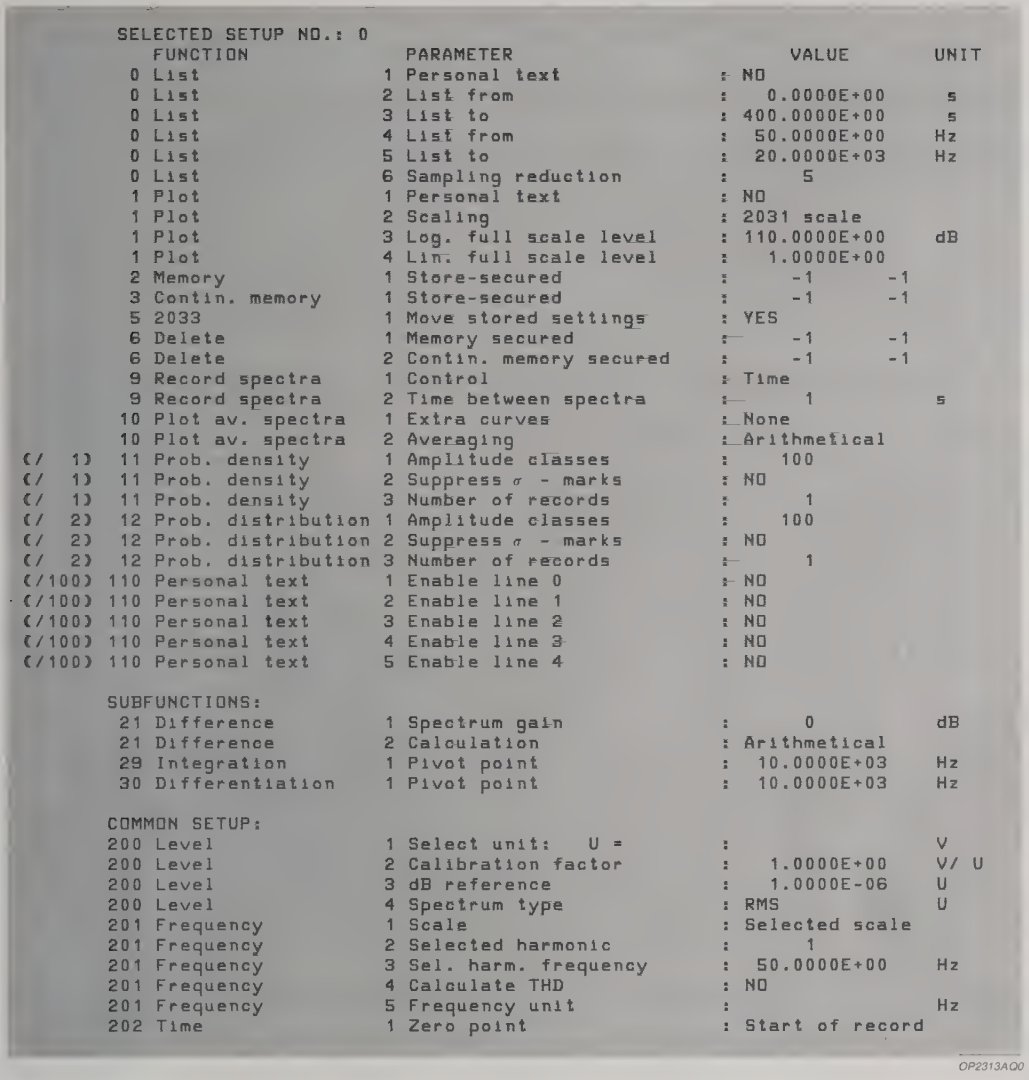
SUBFUNCTIONS:

	21 Difference	1	Spectrum gain	:	0	dB
	21 Difference	2	Calculation	:	Arithmetical	
	26 1/3 oct. spectrum	1	Signal type	:	Stationary	
	27 1/1 oct. spectrum	1	Signal type	:	Stationary	
	29 Integration	1	Pivot point	:	10.0000E+03	Hz
	30 Differentiation	1	Pivot point	:	10.0000E+03	Hz

COMMON SETUP:

	200 Level	1	Select unit: U =	:		V
	200 Level	2	Calibration factor	:	1.0000E+00	V/ U
	200 Level	3	dB reference	:	1.0000E-06	U
	200 Level	4	Spectrum type	:	RMS	U
	201 Frequency	1	Scale	:	Selected scale	
	201 Frequency	2	Selected harmonic	:	1	
	201 Frequency	3	Sel. harm. frequency	:	50.0000E+00	Hz
	201 Frequency	4	Calculate THD	:	NO	
	201 Frequency	5	Frequency unit	:		Hz
	202 Time	1	Zero point	:	Start of record	

Fig. 3.8. Functions and parameters available with Operating Set-Up No: 0 (i.e. Default Set-Up) of Application Package BZ 7002



```
SELECTED SETUP NO.: 0
   FUNCTION              PARAMETER                    VALUE        UNIT
    0 List               1 Personal text          : NO
    0 List               2 List from              :   0.0000E+00    s
    0 List               3 List to                : 400.0000E+00    s
    0 List               4 List from              :  50.0000E+00    Hz
    0 List               5 List to                :  20.0000E+03    Hz
    0 List               6 Sampling reduction     :       5
    1 Plot               1 Personal text          : NO
    1 Plot               2 Scaling                : 2031 scale
    1 Plot               3 Log. full scale level  : 110.0000E+00    dB
    1 Plot               4 Lin. full scale level  :   1.0000E+00
    2 Memory             1 Store-secured          :      -1      -1
    3 Contin. memory     1 Store-secured          :      -1      -1
    5 2033               1 Move stored settings   : YES
    6 Delete             1 Memory secured         :      -1      -1
    6 Delete             2 Contin. memory secured :      -1      -1
    9 Record spectra     1 Control                : Time
    9 Record spectra     2 Time between spectra   :       1      s
   10 Plot av. spectra   1 Extra curves           : None
   10 Plot av. spectra   2 Averaging              : Arithmetical
(/  1) 11 Prob. density  1 Amplitude classes      :     100
(/  1) 11 Prob. density  2 Suppress σ - marks     : NO
(/  1) 11 Prob. density  3 Number of records      :       1
(/  2) 12 Prob. distribution 1 Amplitude classes  :     100
(/  2) 12 Prob. distribution 2 Suppress σ - marks : NO
(/  2) 12 Prob. distribution 3 Number of records  :       1
(/100) 110 Personal text 1 Enable line 0          : NO
(/100) 110 Personal text 2 Enable line 1          : NO
(/100) 110 Personal text 3 Enable line 2          : NO
(/100) 110 Personal text 4 Enable line 3          : NO
(/100) 110 Personal text 5 Enable line 4          : NO

SUBFUNCTIONS:
   21 Difference         1 Spectrum gain          :       0          dB
   21 Difference         2 Calculation            : Arithmetical
   29 Integration        1 Pivot point            :  10.0000E+03     Hz
   30 Differentiation    1 Pivot point            :  10.0000E+03     Hz

COMMON SETUP:
  200 Level              1 Select unit:   U =     :                  V
  200 Level              2 Calibration factor     :   1.0000E+00     V/ U
  200 Level              3 dB reference           :   1.0000E-06     U
  200 Level              4 Spectrum type          : RMS              U
  201 Frequency          1 Scale                  : Selected scale
  201 Frequency          2 Selected harmonic      :       1
  201 Frequency          3 Sel. harm. frequency   :  50.0000E+00     Hz
  201 Frequency          4 Calculate THD          : NO
  201 Frequency          5 Frequency unit         :                  Hz
  202 Time               1 Zero point             : Start of record
```

OP2313AQ00

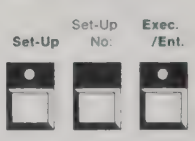
Fig. 3.9. Functions and parameters available with Operating Set-Up No: 0 (i.e. Default Set-Up) of Application Package BZ 7003

The individual Set-Ups are stored in the continuous memory of the Recorder and therefore are not affected by disconnecting mains power to the apparatus. If, however, another Application Package is inserted or the charge state of the internal Ni-Cd battery is allowed to fall below that required to power the continuous memory, then Set-Ups No: 1 to 3 will be automatically reset to the corresponding values of the Default Set-Up (i.e. Operating Set-Up No: 0). Also Operating Set-Up No: 1 will be automatically selected when first powering the instrument, instead of the Set-Up last chosen during previous use.

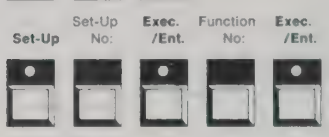
The basic pushkey sequences for selecting the various Set-Up mode levels, are as follows:

Select Clock:

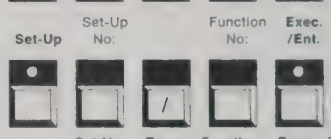
Select Set-Up:



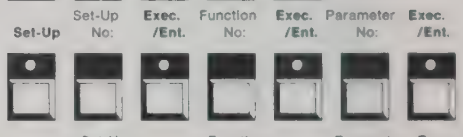
Select Function:



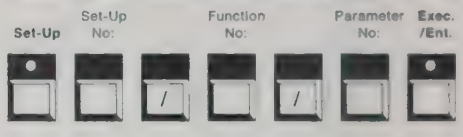
or:



Select Parameter:



or:



further details of which are given in the following sections. If at any stage there is doubt about which Set-Up, Function or Parameter has been entered, or as to which values and units may be entered, press the **Help** key.

3.9.1. Set Clock

For a correct record of date and time at the top of each readout presented by the 2313, the built-in clock of the Recorder must be properly set. This is accomplished as described below and employs the pushkey sequence shown in Fig. 3.10.

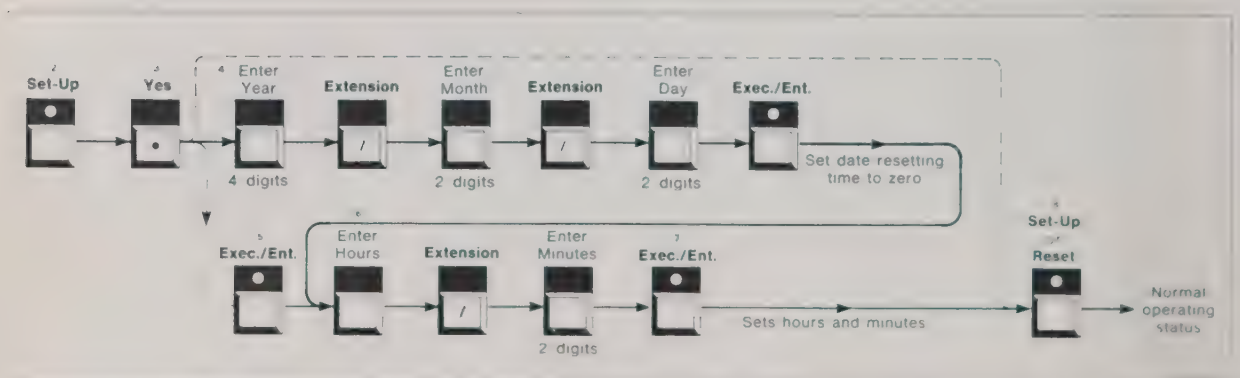


*Fig. 3.10. Use of the **Set-Up** mode for setting date and time with the 2313*

1. Select **Power On**. Either the **Active** or **Entering LED** will light, and the date and time set with the internal clock printed.

```
DATE: 1984-06-01    TIME: 8:30:16
```

If `CONTINUOUS MEMORY AND CLOCK CLEARED` and/or `DATE: 9999-01-01` is printed, check that the internal Ni-Cd battery for the continuous memory is connected before proceeding with step 2. See Section 3.4.

2. Press **Set-Up** to activate the set-up mode plus print the identity of the particular operating Set-Up selected. At the same time the **Set-Up** and **Entering LEDS** will light and, if previously lit, the **Active LED** extinguished.

```
Setup mode, active setup no: 1
```

3. Press **Yes** to activate the set clock mode, as well as print the date and time currently set.

```
Date: 1983-06-01    Time: 8:33:12    Enter Date
```

If both the date and time are correct, go to step 8 to return the 2313 to its initial operating status.

If only the date is correct, press **Exec./Ent.** and go to step 6 to enter the correct time.

4. For entry of the correct date, key-in **[YEAR] [/] [MONTH] [/] [DAY]** in turn. e.g.

To correct a false entry, press **Clear Entry** to delete, and re-enter the **[YEAR] [/] [MONTH] [/] [DAY]**.

5. Press **Exec./Ent.** to set the clock to the entered date and reset the time to zero.

```
Date: 1984-06-12    Time: 00:00:00    Enter time
```

6. To enter the correct time, key-in **[HOURS] [/]** and **[MINUTES]** one minute ahead of actual time. e.g.

To correct a false entry, press **Clear Entry** to delete, and re-enter **[HOURS] [/] [MINUTES]**.

7. Wait until the actual time corresponds to the value entered and press **Exec./Ent.** to set the clock to the correct time.

```
Date: 1984-06-12    Time: 10:45:00    Enter date
```

If the time set is not quite correct, press **Exec./Ent.** one more time and return to step 6.

8. Once the date and time are accurately set, press **Set-Up** to return the 2313 to normal standby status. The **Set-Up LED** should be extinguished and either the **Active** or **Entering LEDs** relit.

3.9.2. Select Set-Up

The "Select Set-Up Level" of the **Set-Up** mode permits selection of a suitable Operating Set-Up for documenting and reformatting measurements. In addition it may be used for listing and setting one or more complete Set-Ups to default. The pushkey sequence employed is as described below and is illustrated in Fig.3.11.

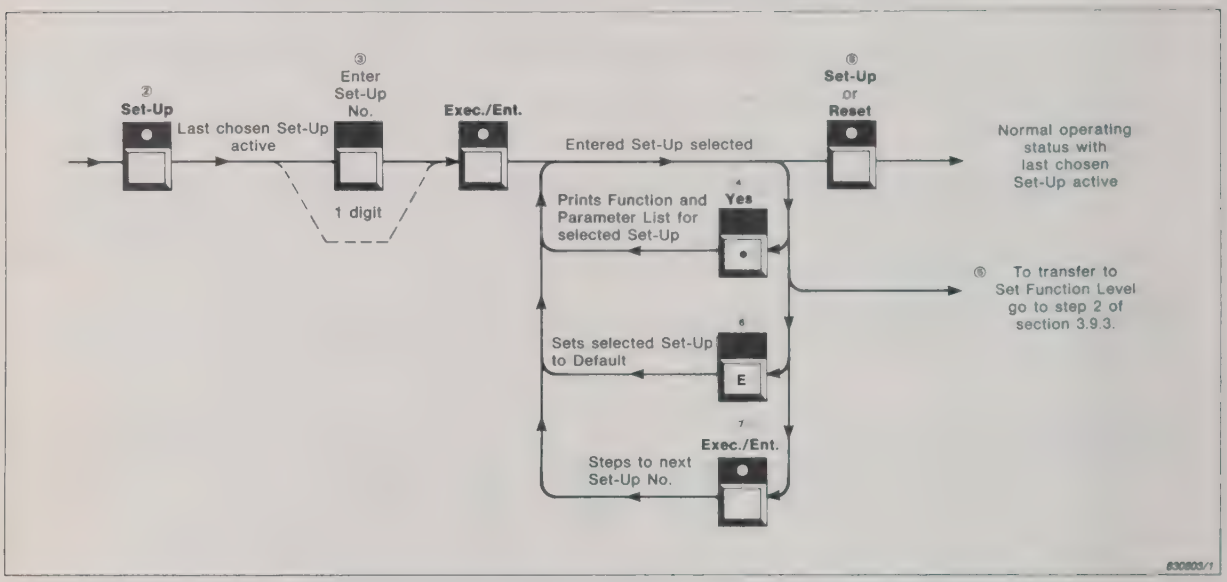


*Fig. 3.11. Use of **Set-Up** mode for selecting and listing of Operating Set-Ups and setting them to default*

1. Select **Power On**. Either the **Active** or **Entering LED** will light, and the date and time set with the internal clock printed.

```
DATE: 1984-06-12      TIME: 10:48:16
```

If `CONTINUOUS MEMORY AND CLOCK CLEARED` and/or `DATE: 9999 -01-01` is printed, check that the internal Ni-Cd battery for the continuous memory is connected before proceeding with step 2. See Section 3.4.

2. Press **Set-Up** to activate the Set-Up mode plus print the identity of the particular operating Set-Up selected. At the same time the **Set-Up** and **Entering LEDS** will light and, if previously lit, the **Active LED** extinguished.

```
Setup mode, active setup no: 1
```

3. Enter the number **[0, 1, 2 or 3]** of the particular Set-Up desired for operation and press **Exec./Ent.** to select the Set-Up. Alternatively, if the desired Set-Up is already active, press **Ent./Ent.** only. The identity of the Set-Up will be printed.

```
SELECTED SETUP NO: 2
```

Steps 4 to 8 may be carried out at the users discretion.

4. For a complete list of the operating functions, parameters and values set with the chosen Set-Up (see Fig. 3.8 and Fig. 3.9), press **Yes**.

5. To set one or more of the operating functions of the Set-Up to default or alter the parameters values of a particular function, go to step 2 of Section 3.9.3 and 3.9.4 respectively.

6. To set the entire Set-Up to the default values set with the DEFAULT SET–UP NO: 0, press **[E]**. The following is printed:

```
Selected setup changed to default
```

7. If another Set-Up is preferred for operation or must be set to default, use the **Exec./Ent.** pushkey to step through each Set-Up in turn, until the required Set-Up is selected.

```
SELECTED SETUP NO: 1
SELECTED SETUP NO: 0
SELECTED SETUP NO: 3
```

8. To return the 2313 to normal standby status with the last chosen Set-Up selected, press **Set-Up** or **Reset**. The **Set-Up LED** should be extinguished and either the **Active** or **Entering LED** relit.

3.9.3. Set Function

The "Set Function Level" of the **Set-Up** mode is useful for listing and setting one or more complete control functions of the different Operating Set-Ups to default. The appropriate pushkey sequence employed is as described below and is shown in Fig.3.12.

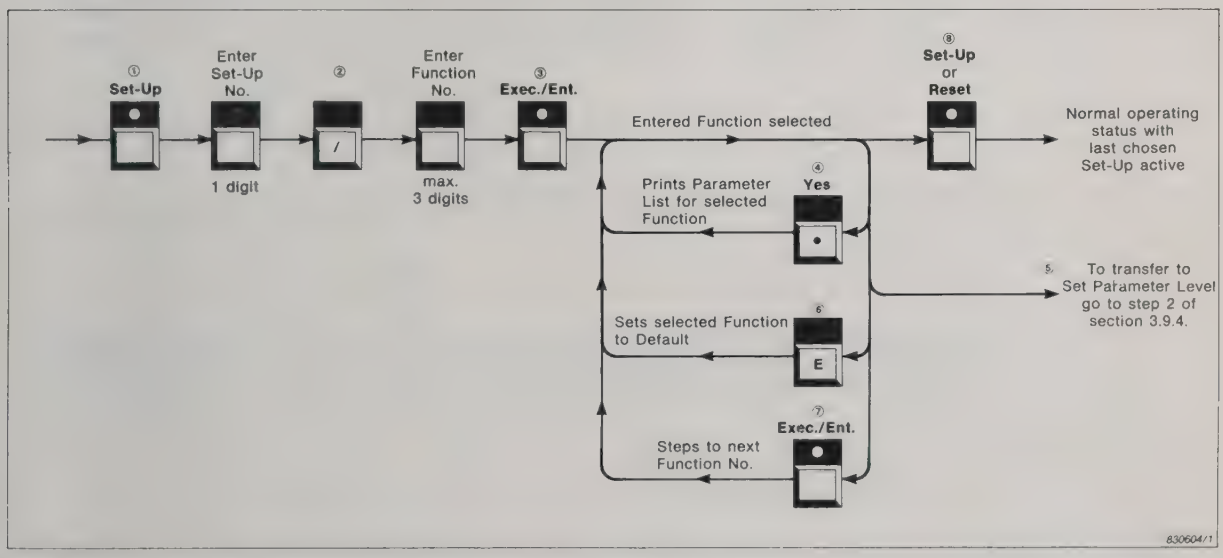


*Fig. 3.12. Use of **Set-Up** mode for selecting and listing of Operating Set-Up Functions plus setting the individual functions to default*

1. Press the **Set-Up** pushkey and enter the number **[0 to 3]** of the particular Set-Up required for operation e.g.

2. Press **Extension[/]** and enter the number **[0 to 202]** of the particular operating function of interest. e.g.

Note: If the required Set-Up has already been selected as in Section 3.9.2, then only the **[Function Number]** should be entered.

To correct a false entry, press **Clear Entry** to delete, and re-enter the **[Set-Up Number] [/] [Function Number]**.

3. Press **Exec./Ent.** to select the entered Set-Up and Function, plus print their identity.

```
SELECTED SETUP NO: 1
2 Memory
```

Steps 4 to 8 may be carried out at the users discretion.

4. For a list of the parameter values set with the selected function, press **Yes**.

```
SELECTED SETUP NO: 1

  FUNCTION              PARAMETER                    VALUE          UNIT
2 Memory              1 Store — secured :          —1      —1
```

5. To alter one or more of the parameter values of the function, go to step 2 of Section 3.9.4.

6. To set the function to the default values set with the corresponding function of the DEFAULT SET–UP NO: 0, press **[E]**. The following is printed:

```
Selected function changed to default
```

7. If another function must be set to default, use the **Exec./Ent.** pushkey to step through each function in turn, until the required function is selected.

```
6 Delete
5 2033
3 Cont. memory
```

8. To return the 2313 to normal operation with the above chosen Set-Up selected, press **Set-Up** or **Reset**. The **Set-Up LED** should be extinguished and either the **Active** or **Entering LED** relit.

3.9.4. Set Parameter and Parameter Value(s)

The "Set Parameter Level" of the **Set-Up** mode is used for selection and alteration of individual control function parameters within the Operating Set-Ups, see Fig.3.13. The values and units to which the parameters may be individually set, depend on the particular control function to which they belong and are as specified in Section 4.2.

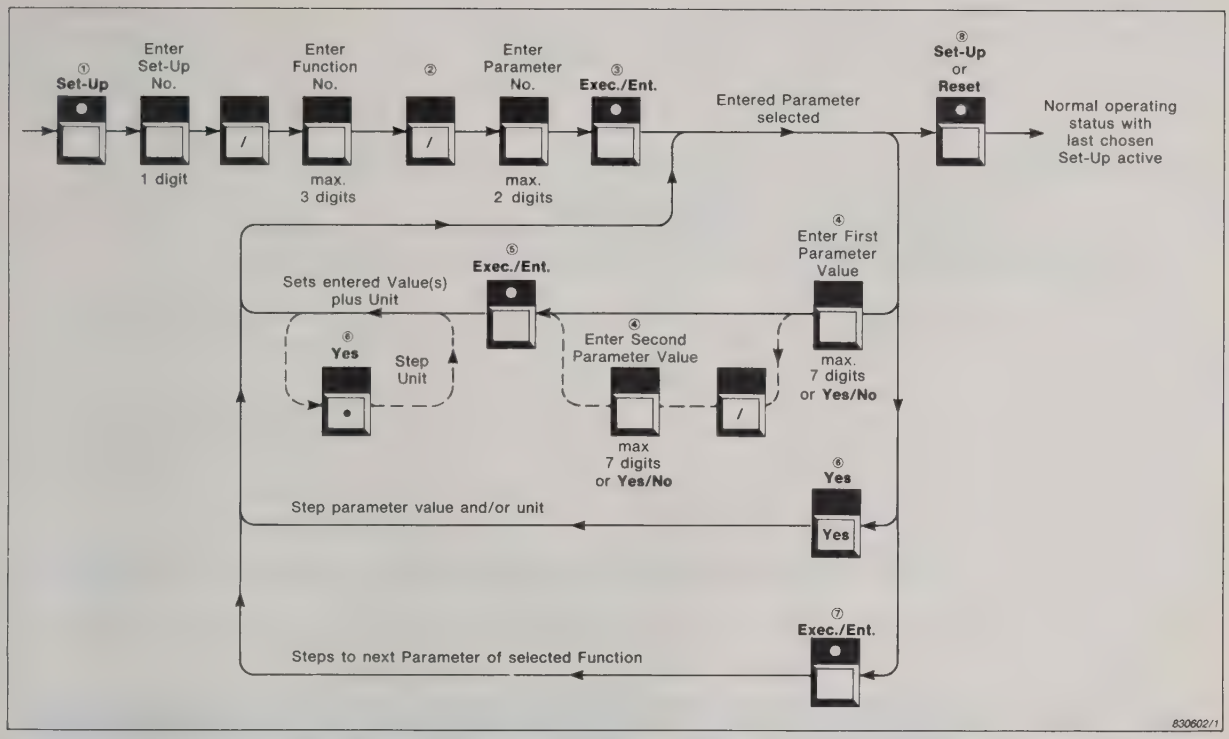


*Fig. 3.13. Use of the **Set-Up** mode for selecting Operating Set-Up parameters plus changing individual parameter values and units*

1. Press the **Set-Up** pushkey and enter the **[Set-Up Number] [/] [Function Number]** of interest e.g.

2. Press **Extension[/]** and enter the number **[0 to 6]** of the particular parameter of interest e.g.

Note: If the required Set-Up and function have already been selected as in Section 3.9.3, then only the **[Parameter Number]** should be entered.

To correct a false entry, press **Clear Entry** to delete, and re-enter the **[Set-Up Number] [/] [Function Number] [/] [Parameter Number]**.

3. Press **Exec./Ent.** to select the entered Set-Up, Function and Parameter, plus print their identity.

```
SELECTED SETUP NO: 1
9 Record spectra      2 Time between spectra      :      1          s
```

4. To alter the parameter value, enter the new value (max. 7 digits for numerical entries in exponetial form e.g. **5.000000E+1**, or logic **Yes**, or **No**). With parameters having two separate values, enter **Extension[/]** after the first value to permit entry of the second.

If unsure of which value to enter, press **Help** for a printout of acceptable values (i.e. Parameter Value Check) plus details of current entry status. Alternatively, refer to Section 4.2 for the particular function selected.

To correct a false entry, press **Clear Entry** to delete, and re-enter the correct value.

5. Press **Exec./Ent.** to set the value(s) entered, plus obtain a print out confirming the value(s) set:

```
9 Record spectra    2 Time between spectra     :      1          s
```

If an incorrect value is entered, an error warning plus parameter value check will be printed e.g.

```
Parameter value not allowed                                ERROR NO: 6

PARAMETER VALUE CHECK:
            1 < values < 1000
```

6. To change the parameter value unit (e.g. s to min. and min. back to s etc.), repeatedly press **Yes** until the required unit is printed e.g.

```
9 Record spectra    2 Time between spectra     :      1          s
9 Record spectra    2 Time between spectra     :      1          min
9 Record spectra    2 Time between spectra     :      1          s
```

7. To step to another parameter of the selected function, ready for entry of new values as in steps 4 to 6, repeatedly press **Exec./Ent.** until the appropriate parameter is printed.

```
9 Record spectra    1 Control                  : Time
9 Record spectra    2 Time between spectra     :      1          s
```

8. To select another function and/or parameter within the same Set-Up, first return to normal operation and then repeat the above procedure.

To return to normal operation with the above Set-Up and parameter values selected, press **Set-Up** or **Reset**. The **Set-Up LED** should be extinguished and either the **Active** or **Entering LED** relit.

9. Step 6 refers to a unit which can be changed by pressing the **Yes** pushkey. The **Yes** pushkey can also be used for changing non-numerical settings which appear under the heading of `VALUE` . One example of this is `2031 scale` or `2033 scale` which pertain to the `Scaling` parameter of the `Plot` Function. The following steps will clarifier this.

10. Press the **Reset** pushkey if not already just been pressed.

11. Press the **Set-Up** pushkey and follow this by pressing **[Set-Up number] [/] [1] [/] [2].**

12. Press **Exec./Ent.** to obtain the following result:

13. By successively pressing the **Yes** pushkey the `Scaling` can be changed to `Auto scale` , `Entered scale` and back to `2031/2033 scale`

14. To revert to normal operation press the **Set-Up** or **Reset** pushkey.

4. USE WITH HIGH RESOLUTION SIGNAL ANALYZER TYPE 2033 OR NARROW BAND SPECTRUM ANALYZER TYPE 2031 PLUS DIGITAL CASSETTE RECORDER TYPE 7400

The BZ 7002 and BZ 7003 Application Packages are designed to expand the capabilities of their respective Analyzers. This is done by producing hard copy results of data that is either taken straight from the Analyzer or is reformatted to produce additional data. Data taken straight from the Analyzer are unmodified and are presented either numerically or graphically. Reformatted, or modified, data are also presented either numerically or graphically but are based on Analyzer data to calculate certain quantities i.e. Average Spectra, Probability Density, Probability Distribution, Difference between two spectra, 1/3 octave band spectra, 1/1 octave band spectra, Integration, Differentiation and THD (Total Harmonic Distortion).

4.1. BASIC ANALYSIS AND RECORDING SET-UP

The basic instrument Set-Up for use of the Graphics Recorder Type 2313 plus Application Package BZ 7002 (or BZ 7003) together with the High Resolution Signal Analyzer Type 2033 (or the Narrow Band Spectrum Analyzer Type 2031) and/or Digital Cassette Recorder Type 7400, is shown in Fig. 4.1. Preparation of the instruments ready for documentation, storage and processing of spectral and time domain data is as described below.

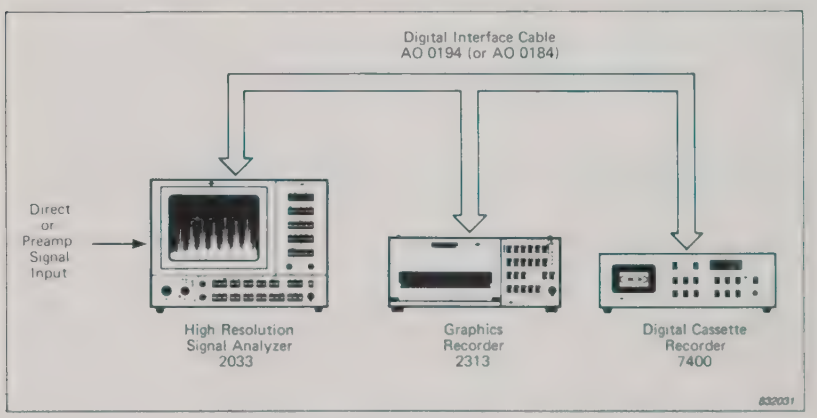


Fig. 4.1. Use of the 2313 Graphics Recorder with the 2033 High resolution signal Analyzer (or the 2031 Narrow Band Spectrum Analyzer) and the 7400 Digital Cassette Recorder

1. Fit the Graphics Recorder with an Application Package BZ 7002 (or BZ 7003), Control Function Overlay SA 0302 (or SA 0303) and roll of Recording Paper QP 4690, as well as carry out other preliminary adjustments necessary. See Chapter 3.

2. Interconnect the **IEC 625 Interface Bus** connectors of the recording and analyzing instrumentation as indicated in Fig. 4.1. If a Digital Cassette Recorder is employed in the Set-Up check that its **Interface Mode** switch is set to **"IEC"**. See Introduction of Chapter 6 for details on appropriate interface cable.

3. Check that the "System Controller Active" mode and appropriate "Metric" or "English" chart length are selected with the **Address Switch** pairs **8** and **7** on the rear panel of the Graphics Recorder (see Fig.4.2).

   Similarly, to permit communication with the other instruments in the setup, set **Address Switch** pairs **A5** to **A1** on the High Resolution Signal Analyzer Type 2033 (or Narrow Band Spectrum Analyzer Type 2031) to **"11001"** and **Multiswitch** pairs **3** to **6** on the Cassette Recorder Type 7400 to **"0111"**.

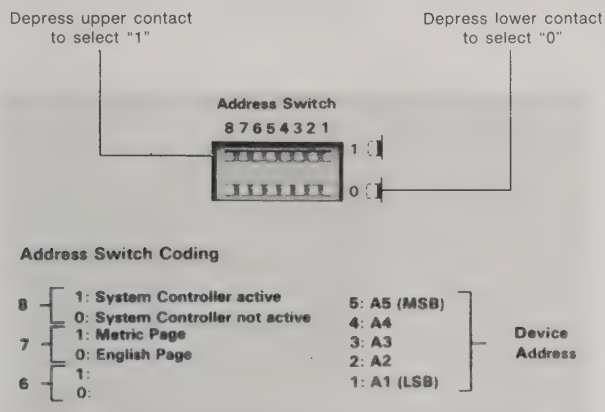


*Fig. 4.2. Selection of "System Controller Active/Not Active", plus "Metric" and "English" chart length with the **Address Switch** of the 2313*

4. Select **Power On**, and press the **Reset** key on the Graphics Recorder. The 2313 will then print the date and time set with its internal clock, plus light the **Active LED** indicating that it is ready for use as a system controller.

   Note: If `CONTINUOUS MEMORY AND CLOCK CLEARED` and/or `DATE: 9999-01-01` is printed, check that the internal Ni-Cd battery of the Graphics Recorder memory is connected before proceeding with step 5. See section 3.4.

5. Using the **Set-Up** key of the Recorder, activate the Set-Up mode to set correct date and time with the built-in clock, plus select the particular Operating Set-Up of interest for recording measurements. See section 3.9.

6. Apply the signal to be analyzed and set the puskeys of the Analyzer to obtain a suitable display on the instrument.

7. Fit the Digital Cassette Recorder with a Tape Cassette ready for recording and/or replay of measurements from the Analyzer.

The measurement Set-Up is now ready for use with the IEC interface and front panel pushkeys of the Graphics Recorder exercising full control over the other instruments in the Set-Up. The relevant pushkey commands used for transfer of measurement data

from one instrument to another, including details on the different control functions used for documenting, storage and reformatting of measurements are given in section 4.2.

4.2. CONTROL FUNCTIONS

The basic syntax for documenting, storing and processing of measurement data with the 2313 is the same regardless of which application package is employed. First the DESTINATION must be entered and then the SOURCE e.g.

	DESTINATION	SOURCE	
	[List]	***[2033]***	**[Exec./Ent.]**
or	**[Plot]**	***[Memory]*** **[/]** [file no.]	**[Exec./Ent.]**
or	**[7400]** [file no.]	**[/]** ***[Memory]*** **[/]** [file no.]	**[Exec./Ent.]**

Data Destination and Source

In general, DESTINATIONS are described by the functions printed in plain text on the Control Function Overlay provided with the Application Package. Following entry of a function the **Active LED** is extinguished and the **Entering LED** is lit instead. This indicates that the 2313 is ready to receive information on the SOURCE which is described by the sub-functions printed in cursive text on the Overlay. Alternatively, numbers can be entered for specifying which memory or tape file a measurement is to be sent to, provided that this is followed by **Extension [/]** to permit entry of the SOURCE. If no SOURCE is specified then the ***2033*** (or ***2031***)is automatically chosen, while if no memory or tape file number is specified for output of a stored or recorded measurement, then memory file 0 or the currently selected tape file is selected.

Repetition of Measurement Task

Once a specific documentation, storage or measurement task has been executed, and the **Active LED** of the 2313 is relit, the same task can be repeated simply by pressing the **Exec./Ent.** pushkey. At the same time this will automatically update the memory or tape file locations of the DESTINATION and SOURCE so that the next file is chosen. Thus a whole series of separate measurements may be documented or stored in successive memory or tape files without having to re-enter the entire pushkey sequence each time.

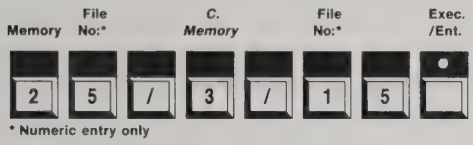
Help Information

If a false entry is made, then it may be corrected prior to execution simply by pressing the **Clear Entry** pushkey and entering the entire sequence afresh. Similarly, execution of an unwanted function or task can be terminated by activating the **Reset** key. Where there is doubt about which function, sub-function and file numbers have been entered, the current status of the entry can be printed by activating **Help**.e.g.

```
Selected overlay function:   2

Entered value :     5            / 3            / 15
```

corresponds to the following pushkey command:



Stores measurement in V. Memory file 5 from C. Memory file 15

4.2.1. List [0] – Function No: 0

With the **List** function of the 2313, measurements displayed on the 2033 (or 2031) can be documented as shown in Fig. 4.3. Either time domain or frequency domain measurements can be printed depending on the INPUT FUNCTION settings of the 2033 (or 2031). Also, details on instrument control settings, personal text, plus date and time of each readout are printed as part of the documentation heading. The position of the 2033 (or 2031) cursor is also indicated (if not excluded by sampling reduction). Similarly the maximum frequency component is indicated as well as the positive and negative peaks of the time domain function.

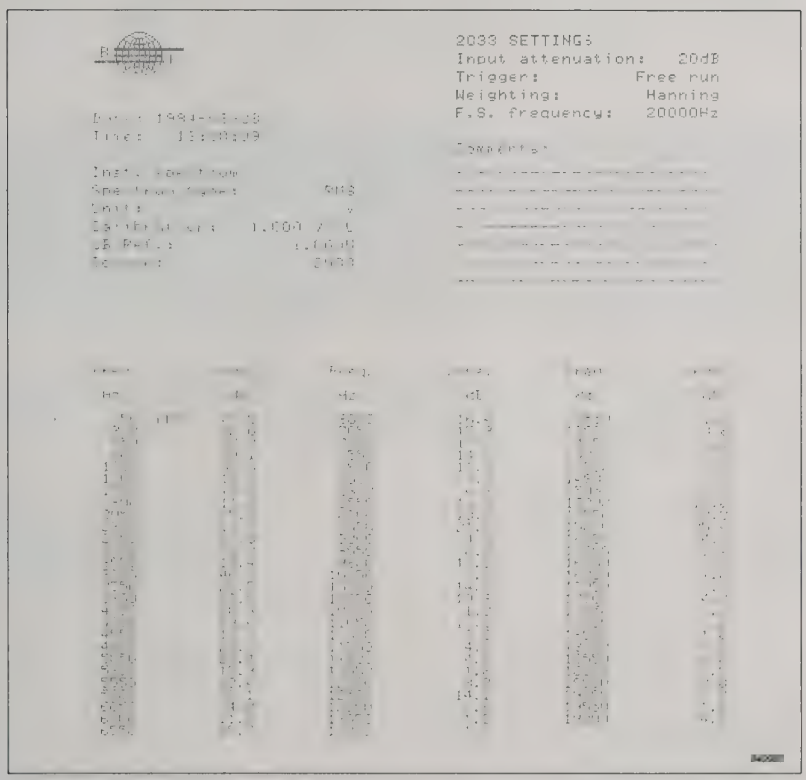


Fig. 4.3. Typical listing of spectral data measured with the 2033 High Resolution Signal Analyzer

The data types intended for use with the **List** function are as follows:

Spectrum	400 line (Baseband)
	High Resolution (2033 only)
	Averaged

	Ref. Spectrum (stored in Analyzer Memory) Spectrum difference (2313 Function) Spectrum Ratio (I/M 2033, I–M 2031)
Time Function	10 K (2033 only) 1 K
Differentiation	Single and double
Integration	Single and double
Spectrum Conversion	Power Power Spectral Density Energy Spectral Density

Operating Set-Up Parameters

The user accessible parameters controlling documentation produced by the **List** function have the parameter numbers and identities specified below. These are accessible with Operating Set-Ups Nos: 1, 2 and 3 of the 2313 and to suit different types of measurement may be used to alter the readout by assigning them the parameter values indicated.

SELECTED SETUP NO.: 0

FUNCTION	PARAMETER		VALUE	UNIT
0 List	1	Personal text	: NO	
0 List	2	List from	: 0.0000E+00	s
0 List	3	List to	: 200.0000E-03	s
0 List	4	List from	: 50.0000E+00	Hz
0 List	5	List to	: 20.0000E+03	Hz
0 List	6	Sampling reduction	: 5	

1–Personal text: Accepts logic **Yes** or **No** with **No** as default. Decides whether or not user selected text is to accompany the listing of measured data. If no personal text is required then **No** should be selected in the Set-Up. If personal text is required then **Yes** should be selected in the Set-Up. See section 4.2.20.

2–List from and **3–List to:** Accept any value from 0 to 10240 s with default at 0 and 0,2 s respectively for the 2033 and 0 and 400 s for the 2031 (these are printed, and can be entered, in exponential form e.g. 0,2 is printed as **200.0000E-03**). They set the times of the first and last listed sample quantities of a displayed time domain function.

4–List from and **5–List to:** Accept any value from 0,000 25 to 20 000 Hz for the 2033 and 0,0025 to 20 000 Hz for the 2031 with default at 50 and 20 000 Hz respectively (these are printed, and can be entered, in exponential form e.g. 50 Hz is printed as **50.0000E+00**). They set the frequencies of the first and last listed sample quantities of a displayed frequency domain function.

6–Sampling reduction: Accepts any value from 1 to 50. Default setting is 5. Decides that only every n^{th} sample will be listed where **n** is the **Sampling reduction**.

For further details on the use of Operating Set-Ups Nos: 1, 2 and 3, section 3.9 should be consulted.

It should be noted that the desired listing range should first be covered by the display on the screen of the Analyzer. This applies especially to time functions and when using the "Zoom" facility on the 2033.

Lists are printed in three columns. To limit the amount of paper used the **Sampling reduction** default value is 5. Generally a list will be made to cover a particular small range decided by the **List to** and **List from** parameters with a **Sampling reduction** of 1 i.e. every sample value is listed.

In addition to **List** mentioned above there are functions in a COMMON SET-UP (see Sections 4.2.33 and 4.2.34) which allow various units, such as Voltage, Newtons, Pounds Force etc., to be allocated to the amplitude of the listed quantities. There are also facilities for expressing the frequency scales in terms of Hertz, Harmonics and rpm.

If the **Harmonic scale** (Function 201, Parameter 1) in the COMMON SETUP is chosen and **Calculate THD** (Function 201, Parameter 4) is set to **Yes** then the values will be listed as percentages of the first harmonic. If the spectrum type is different from RMS, then the percentage values will be squared to give harmonic power content in percentage, e.g. 3,5% will be squared ($0{,}035^2$) to give 0,1% after rounding up.

Basic Pushkey Commands

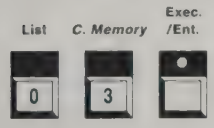
For listing measurements from various sources and/or performing operations on the results the following pushkey sequences apply:

Lists data displayed on Analyzer screen.

Lists difference between spectra stored in V. Memory files X and Y i.e. X–Y.

Lists data stored in V. Memory file 0.

Lists data stored in V. Memory file X.



Lists data stored in C. Memory 0.

Lists data stored in C. Memory X.

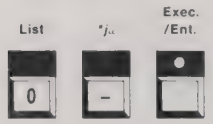
Lists data of current 7400 tape file.

Lists data of 7400 tape file X.

Lists data displayed on 2033 Analyzer.

Lists data displayed on 2031 Analyzer.

Lists data stored in Temp. Mem.



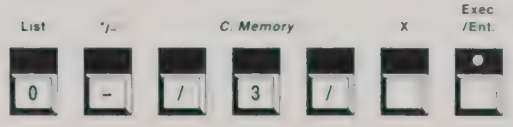
Lists result of time differentiated signal of displayed spectrum.

Lists result of time differentiated signal of displayed spectrum.

Lists result of time differentiated signal of displayed spectrum.

Lists result of time differentiated signal whose spectrum is stored in Temp. Mem.

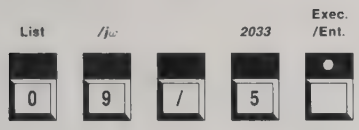
Lists result of time differentiated signal whose spectrum is stored in V. Memory file X.



Lists result of time differentiated signal whose spectrum is stored in C. Memory file X.

Lists result of time differentiated signal whose spectrum is stored on 7400 tape file X.

Lists result of time integrated signal of displayed spectrum.



Lists result of time integrated signal of displayed spectrum.

Lists result of time integrated signal of displayed spectrum.

Lists result of time integrated signal whose spectrum is stored in Temp. Mem.

Lists result of time integrated signal whose spectrum is stored in V. Memory file X.

Lists result of time integrated signal whose spectrum is stored in C. Memory file X.

Lists result of time integrated signal whose spectrum is stored 7400 tape file X.

where X and Y can be assigned any memory file number from 0 to 31 999 and 1 to the highest used 7400 tape file number.

Following each readout **List** can be reactivated simply by pressing the **Exec./Ent.** pushkey. This will list the measurement stored in the next file, thus making it possible to document a second or third stored measurement etc. without having to enter the entire pushkey sequence each time. Any attempt to access a non existent file will result in an appropriate error message being printed, plus return the 2313 to normal standby status. For listing subsequent files a new pushkey sequence must be entered afresh.

List Pushkey sequences

The pushkey sequences illustrated above can also be illustrated by a chart where each individual sequence can be traced from left to right. Fig 4.4 shows all usable pushkey sequences for the **List** function. Any path from left to right represents a valid pushkey sequence and, depending upon which sequence is traced, will determine what operations if any will be performed on the listed data. Pushkeys are itemised by the characters in square brackets and correspond either with what appears on the pushkey itself or just above it. The **X** and **Y** refer to file numbers used for Tape, Volatile or Continuous memories.

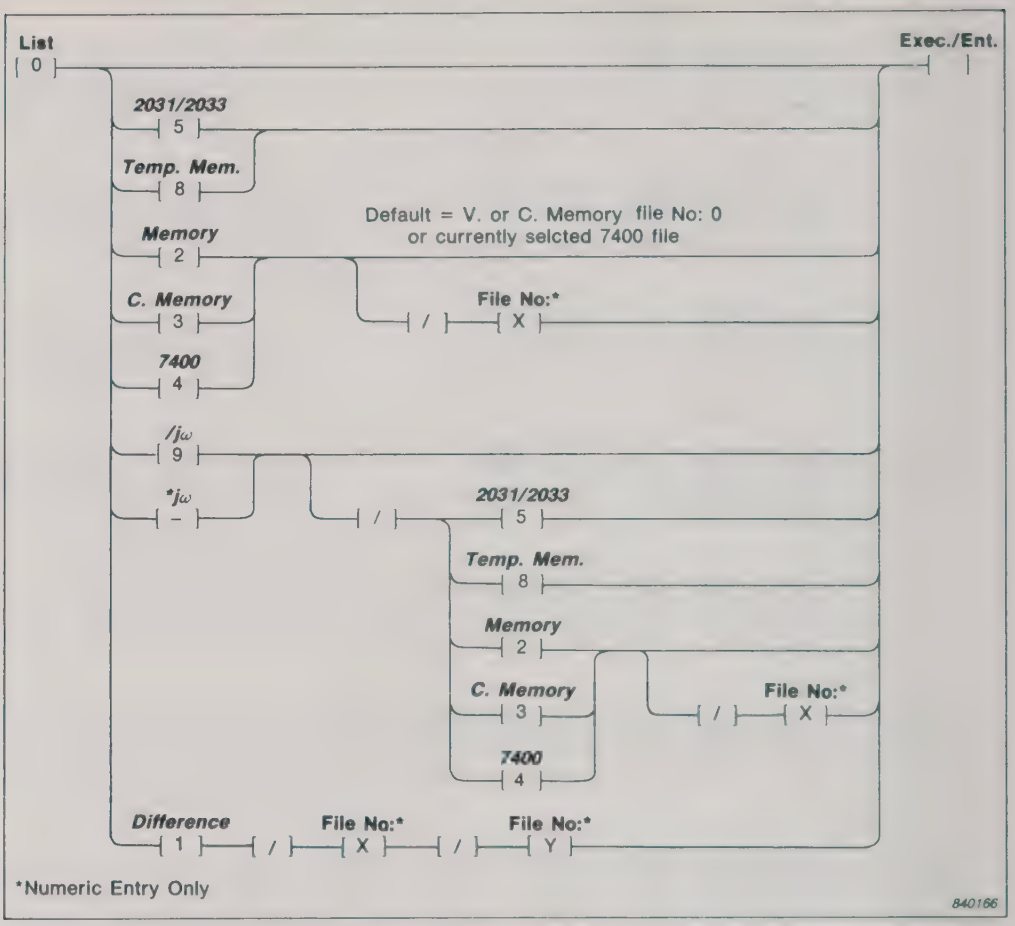


Fig. 4.4. Chart for all usable pushkey sequences beginning with ***List***

4.2.2. Plot [1] – Function No: 1

The **Plot** function generates fully annotated graphic plots of measurements displayed on the 2033 (or 2031). A typical example is illustrated in Fig. 4.5. Either time domain or frequency domain measurements can be plotted depending on the INPUT FUNCTION settings of the 2033 (or 2031). As with the **List** function, details on instrument control settings, personal text, plus date and time of each plot are printed as part of the documentation heading.

Frequency domain plots make use of all 400 lines and are furnished with information on cursor line number and corresponding frequency and level as well as the maximum value and its line number and frequency. Where a storage medium is either a continuous or volatile memory and two file numbers are specified, then two spectra will be plotted simultaneously.

All time domain plots are drawn using 1024 (1 K) data points and are furnished with information on cursor line number and corresponding time and level as well as the maximum and minimum values and their line numbers and times. In the case of the 2033, if TIME FUNCTION "390" is chosen, or in the case of the 2031 "Expand" is chosen, then the plot will consist of 1 K data points but with the extremities of the displayed 390 lines indicated by arrow heads thus · and thus · at the top edge of the plot. Also, in the

case of the 2033, the 10 K time function will be compressed to 1024 data points before being plotted. This is done by segmenting the 10 K into samples of 20 and representing the 20 samples by a line drawn between their maximum and minimum values.

The data types intended for use with the **plot** function are as follows:

Spectrum	400 line (Baseband) High Resolution (2033 only) Averaged Ref. Spectrum (stored in Analyzer Memory) Spectrum difference (2313 Function) Spectrum Ratio (I/M 2033, I–M 2031)
Time Function	10 K (2033 only) 1 K
Constant Percentage Bandwidth	1/3 octave, 1/1 octave
Differentiation	Single and double
Integration	Single and double
Spectrum Conversion	Power Power Spectral Density Energy Spectral Density

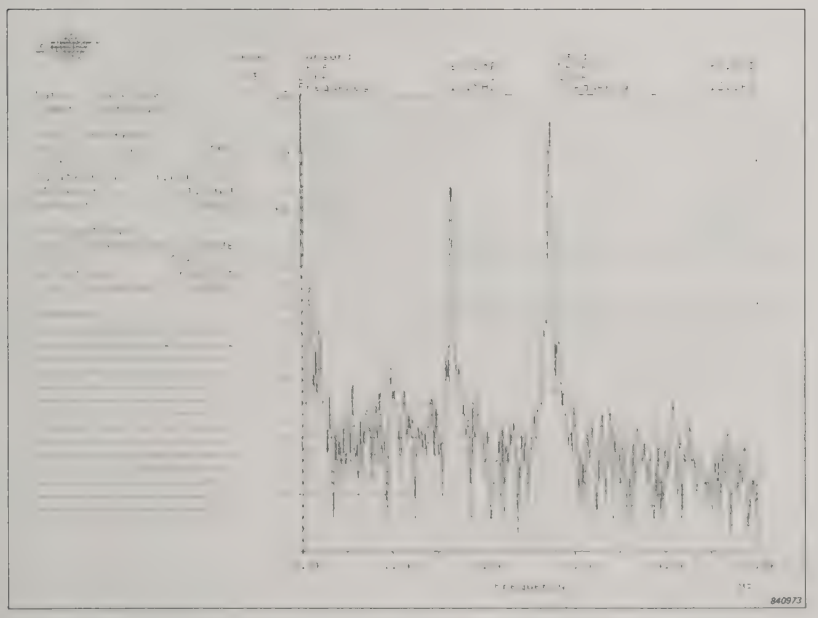


Fig. 4.5. Typical plot of spectral data measured with the 2033 High Resolution Signal Analyzer

Operating Set-Up Parameters

The user accessible parameters controlling documentation produced by the **Plot** function have the parameter numbers and identities specified below. These are accessible with operating Set-Ups Nos. 1, 2 and 3 of the 2313 and to suit different types of measurement may be used to alter the readout by assigning them the parameter values indicated.

```
SELECTED SETUP NO.: 0
   FUNCTION              PARAMETER                    VALUE        UNIT
 1 Plot          1 Personal text          : NO
 1 Plot          2 Scaling                : 2033 scale
 1 Plot          3 Log. full scale level  : 110.0000E+00    dB
 1 Plot          4 Lin. full scale level  :   1.0000E+00
```

1–Personal text: Accepts logic **Yes** or **No** with **No** as default. Decides whether or not user selected text is to accompany the plot of measured data. If no personal text is required then **No** should be selected in the Set-Up. If personal text is required then **Yes** should be selected in the Set-Up. See section 4.2.20.

2 – Scaling: Three possibilities exist for scaling. The default case is the one shown above i.e. **2033 scale** (or **2031 scale**). The other two are **Auto scale** and **Entered scale** which can be obtained by pressing the **Yes** pushkey at the appropiate level of the Set-Up procedure. See section 3.9.4.

If the **2033 scale** (or **2031 scale**) is selected then the plots will be a facsimile of the data displayed on the screen of the 2033 (or 2031)

If **Auto scale** is selected then the plots will be made with the vertical axis optimised to give the best graphical result.

The **Entered scale** allows the user to decide the full scale level of the logarithmic and linear plots. The default levels are as shown above, these are printed, and may be entered, in exponential form. Acceptable entered values for the full scale levels range as follows:

`3 Log. full scale level` –500 to +500

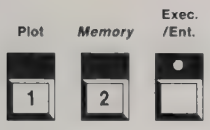
`4 Lin. full scale level` 10^{-30} to 10^{30}

Basic Pushkey Commands

For plotting measurements from various sources and/or performing operations on the results, the following pushkey sequences apply:

Plots displayed data.

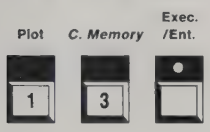
Plots difference between spectra stored in V. Memory files X and Y. i.e. X – Y.



Plots data stored in V. Memory file 0.

Plots data stored in V. Memory file X.

Plots data stored in V. Memory files X and Y.



Plots data stored in C. Memory file 0

Plots data stored in C. Memory file X.

Plots data stored in C. Memory files X and Y.

Plots data stored on current 7400 tape file

Plots data stored on 7400 tape file X.

Plots data displayed on 2033 Analyzer

Plots data displayed on 2031 Analyzer

Plots 1/3 octave band data of displayed spectrum.

Plots 1/1 octave band data of displayed spectrum.

Plots data stored in Temp. Mem.

Plots result of time differentiated signal of displayed spectrum.

Plots result of time differentiated signal of displayed spectrum.

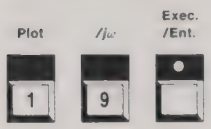
Plots result of time differentiated signal of displayed spectrum.

Plots result of time differentiated signal whose spectrum is stored in Temp. Mem.

Plots result of time differentiated signal whose spectrum is stored in V. Memory file X.

Plots result of time differentiated signal whose spectrum is stored in C. Memory file X.

Plots result of time differentiated signal whose spectrum is stored on 7400 tape file X.

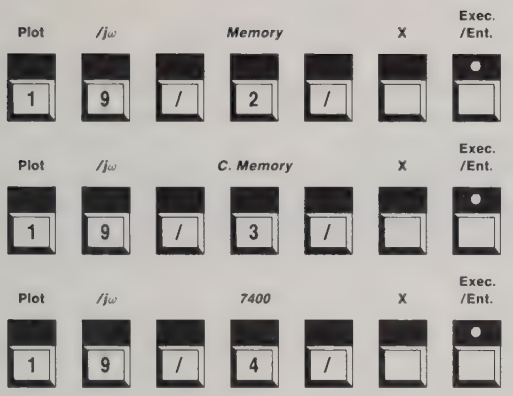


Plots result of time integrated signal of displayed spectrum.

Plots result of time integrated signal of displayed spectrum.

Plots result of time integrated signal of displayed spectrum.

Plots result of time integrated signal whose spectrum is stored in Temp. Mem.



where X and Y can be assigned any memory file number from 0 to 31 999 and 1 to the highest used 7400 tape file number.

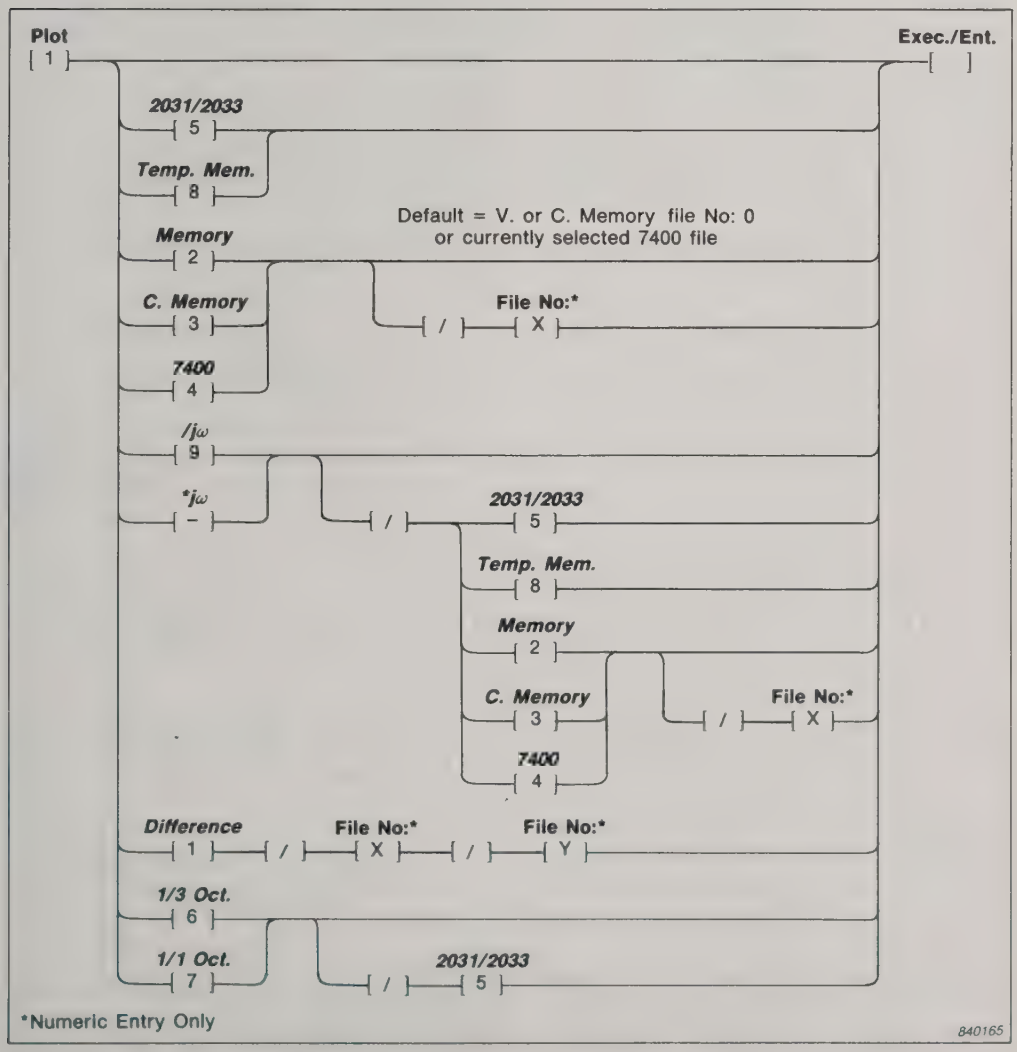


Fig. 4.6. Chart for all usable pushkey sequences beginning with ***Plot***

Plot Pushkey Sequences

The pushkey sequences illustrated above can also be illustrated by a chart where each individual sequence can be traced from left to right. Fig 4.6 shows all usable pushkey sequences for the **Plot** function. Any path from left to right represents a valid pushkey sequence and, depending upon which sequence is traced, will determine what operations if any will be performed on the plotted data. Pushkeys are itemised by the characters in square brackets and correspond either with what appears on the pushkey itself or just above it. The **X** and **Y** refer to file numbers used for Tape, Volatile or Continuous memories.

4.2.3. Move to Volatile Memory [2] – Function No: 2

Using the memory of the 2313, individual measurements comprising of spectra, time domain signals, control settings etc. can be stored for future use. These are filed in the volatile memory and therefore may be retained as long as the Recorder remains powered from the mains supply. Not only can the stored measurements be retained for documentation at a later time during current use, but they can also be read out to the 2033 (or 2031), the 7400 or be subjected to further processing by the 2313. The maximum number of measurements which may be filed will depend upon the type of measurement and is as follows:

62 × spectra
or 26 × 1 K time functions
or 2 × 10 K time functions (2033 only)

The data types intended for use with the **Move to Volatile Memory** Function are as follows:

Spectrum	400 line (Baseband) High Resolution (2033 only) Averaged Ref. Spectrum (stored in Analyzer Memory) Spectrum difference (2313 Function) Spectrum Ratio (I/M 2033, I–M 2031)
Time Function	10 K (2033 only) 1 K
Constant Percentage Bandwidth	1/3 octave, 1/1 octave
Differentiation	Single and double
Integration	Single and double
Spectrum Conversion	Power Power Spectral Density Energy Spectral Density

Operating Set-Up Parameters

To help safeguard stored measurements, Operating Set-Ups Nos: 1, 2 and 3 are equipped with the following control parameters:

FUNCTION	PARAMETER		VALUE	UNIT
2 Memory	1 Store-secured	:	—1 —1	
6 Delete	1 Memory secured	:	—1 —1	

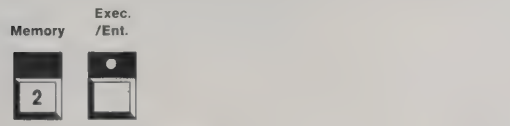
These accept values from –1 to 31999 and permit any group of consecutive memory files to be store- or delete secured simply by entering the numbers of the first and last files of the the group to be protected. Also vacant files can be secured so that once a measurement has been stored in a vacant file, subsequent attempts to delete or store new data in the same file will be blocked by the Recorder. If —1 is entered, as for the default case shown above, then no store- and delete secured facilities will be rendered.

A particularly important point to note, is that files remain secured only whilst operating with the particular Operating Set-Up in which they are store and delete secured. Consequently for reliable protection of stored data, it is important that the same files secured with Set-Up No: 1, for example, are also secured with Set-Ups No: 2 and 3. Also care must be exercised if the Default Set-Up No: 0 is chosen, since it is not possible to secure stored data with this Set-Up. In this case it is recommended that the **Memory Menu** function of the recorder be activated (see section 4.2.8.). This itemises which files are already occupied by the four Operating Set-Ups of the Recorder.

For further details on the use of Operating Set-Ups, section 3.9 should be consulted.

Basic Pushkey Commands

For storing measurements in volatile memory, the following pushkey sequences apply.



Stores measurement in V. Memory file 0 from the 2033 (2031)

Stores measurement in V. Memory file X from the 2033 (2031)

Stores Analyzer switch settings in V. Memory file X

Stores measurement in V. Memory file X from V. Memory file 0

Stores measurement in V. Memory file X from V. memory file Y

Stores measurement in V. Memory file X from C. Memory file 0

Stores measurement in V. Memory file X from C. Memory file Y

Stores measurement in V. Memory file X from currently selected 7400 file

Stores measurement in V. Memory file X from 7400 file Y

Stores measurement in V. Memory file X from the 2033

Stores measurement in V. Memory file X from the 2031

Stores measurment in V. Memory file X from 2313 temp. mem.

Activates a three pass 1/3 oct. band analysis storing results in V. Memory file X (2033 only)

Activates a three pass 1/1 oct. band analysis storing results in V. Memory file X (2033 only)

where X and Y can be assigned any memory file number from 0 to 31 999 and 1 to the highest used 7400 tape file number.

Pressing **Exec./Ent.** a second or third time after entry of any of the above sequences automatically updates the file numbers thereby storing data in the next adjacent file provided this is free for storing measurements, e.g.

Stores measurement in V. Memory file X from C. Memory file Y

Exec.
/Ent.

etc. . .

Stores measurement in V. Memory file X+n from C. Memory file Y+n, where "n" is the number of times **Exec./Ent.** is pressed

Any attempt to store data in a store-secured file already containing data or transfering data from an empty file will permanently interrupt the above sequence plus print an error message.

Move to Memory Pushkey sequences

The pushkey sequences illustrated above can also be illustrated by a chart where each individual sequence can be traced from left to right. Fig 4.7 shows all usable pushkey sequences for the **Memory** function. Any path from left to right represents a valid pushkey sequence and, depending upon which sequence is traced, will determine what operations if any will be performed on the stored data. Pushkeys are itemised by the characters in square brackets and correspond either with what appears on the pushkey itself or just above it. The **X** and **Y** refer to file numbers used for Tape, Volatile or Continuous memories.

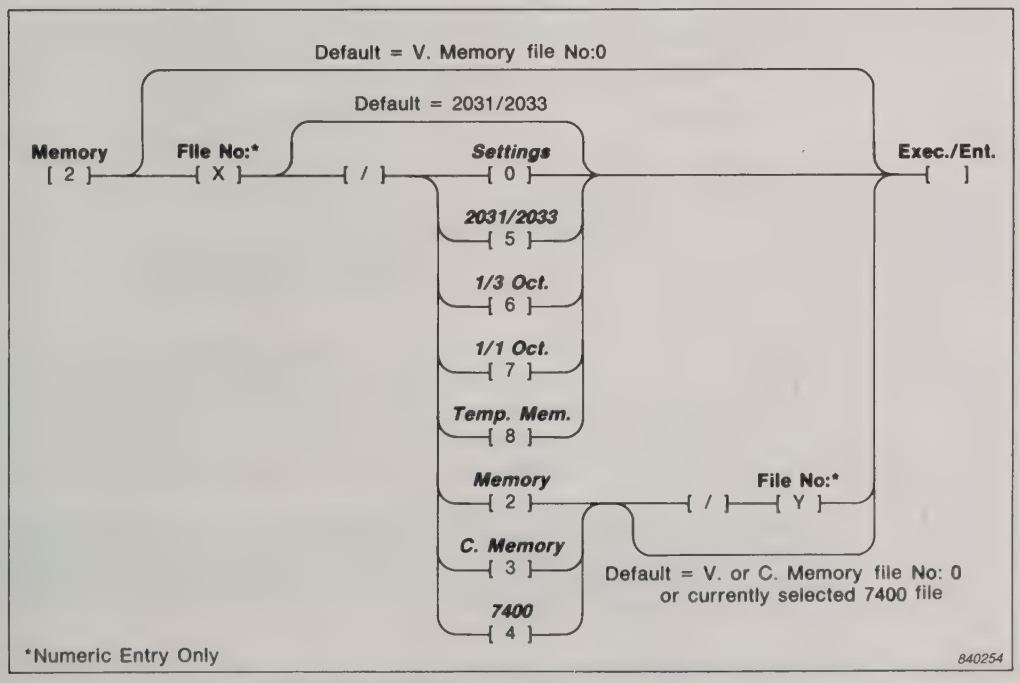


Fig. 4.7. Chart for all usable pushkey sequences beginning with ***Memory***

4.2.4. Move to Continuous Memory [3] – Function No: 3

This is similar to the **Memory** function. An important difference is that measurements can be stored indefinitely, provided that the continuous memory is kept powered by the built-in Ni-Cd battery of the 2313 (see section 3.4). The maximum number of measurements which may be stored is as follows:

2 × spectra
or 1 × 1 K time function
or 9 × 2033/2031 settings

The data types intended for use with the **Move to Continuous Memory** Function are as follows:

Spectrum	400 line (Baseband) High Resolution (2033 only) Averaged Ref. Spectrum (stored in Analyzer Memory) Spectrum difference (2313 Function) Spectrum Ratio (I/M 2033, I–M 2031)
Time Function	1 K
Constant Percentage Bandwidth	1/3 octave, 1/1 octave
Differentiation	Single and double
Integration	Single and double
Spectrum Conversion	Power Power Spectral Density Energy Spectral Density

The pushkey commands used for storing measurements are the same as those indicated in section 4.2.3. except that the **C. Memory** pushkey is used to initiate each sequence instead of the **Memory** pushkey. Likewise any group of successive continuous memory files may be secured using the following control parameters which, except for function and parameter numbers indicated, are the same as those described in section 4.2.3.

FUNCTION	PARAMETER		VALUE		UNIT
3 Contin. memory	1 Store-secured	:	—1	—1	
6 Delete	2 Contin. memory secured	:	—1	—1	

Move to Continuous Memory Pushkey sequences

The pushkey sequences mentioned above can also be illustrated by a chart where each individual sequence can be traced from left to right. Fig 4.8 shows all usable pushkey sequences for the **Continuous Memory** function. Any path from left to right represents a valid pushkey sequence and, depending upon which sequence is traced, will determine what operations if any will be performed on the stored data. Pushkeys are itemised by the characters in square brackets and correspond either with what appears on the pushkey itself or just above it. The **X** and **Y** refer to file numbers used for Tape, Volatile or Continuous memories.

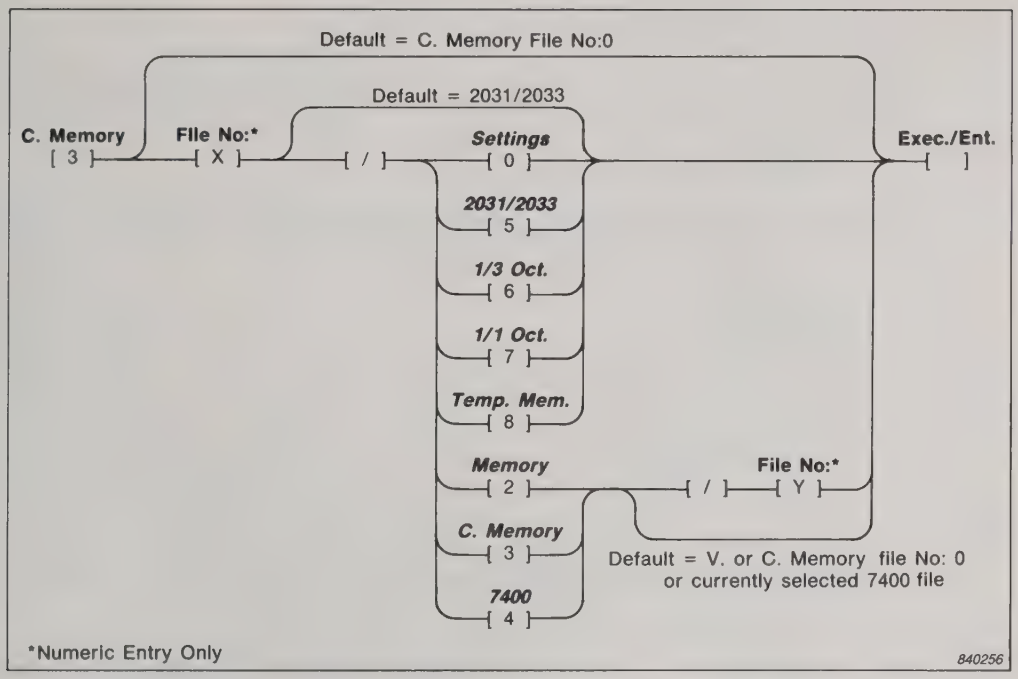


Fig. 4.8. Chart for all usable pushkey sequences beginning with ***Cont. Memory***

4.2.5. Move to 7400 [4] – Function No: 4

This function is useful for recording with the Digital Cassette Recorder Type 7400. Measurements presented on the display screen of the Analyzer can be recorded, plus those stored or processed using the 2313. The approximate number of measurements which can be stored per side of a Digital Tape Cassette containing 300 m of tape is as follows:

11 × 10 K time functions
or 98 × 1 K time functions
or 210 × Spectra (all types)

The data types intended for use with the **Move to 7400** function are as follows:

Spectrum	400 line (Baseband) High Resolution (2033 only) Averaged Ref. Spectrum (stored in Analyzer Memory) Spectrum difference (2313 Function) Spectrum Ratio (I/M 2033, I–M 2031)
Time Function	10 K (2033 only) 1 K
Constant Percentage Bandwidth	1/3 octave, 1/1 octave
Differentiation	Single and double
Integration	Single and double

Spectrum Conversion	Power Power Spectral Density Energy Spectral Density

Basic Pushkey Commands

For recording measurements in a 7400 file, the following pushkey sequences apply:

Records measurement in currently selected 7400 file from 2033 (or 2031).

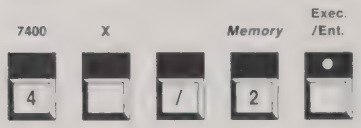
Records measurement in 7400 file X from 2033 (or 2031)

Stores Analyzer pushkey settings on 7400 tape file X

Records measurement in 7400 file X from 2033

Records measurement in 7400 file X from 2031

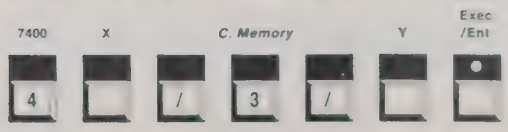
Records measurement in 7400 file X from 2313 temp. mem.



Records measurement in 7400 file X from V. Memory file 0

Records measurement in 7400 file X from V. Memory file Y

Records measurement in 7400 file X from C. Memory file 0.



Records measurement in 7400 file X from C. Memory file Y

Records measurement in 7400 file X from currently selected 7400 file

Records measurement in 7400 file X from 7400 file Y

where X and Y can be assigned any memory file number from 0 to 31 999 or tape file number from –1 (excepting 0) to the highest used file number. With the 7400, measurements are recorded sequentially with File No: allocated by the Recorder. This means that when a blank Tape Cassette is fitted, no tape file number should be entered as the destination (i.e. File No: X) since the 7400 automaticaly selects file no: 1 for recording the first measurement, file no: 2 for the second measurement, and so on. If, however, a tape already containing recorded measurements is used then tape File No:–1 (i.e.**[–][1]**) should be entered as the destination. This will spool the tape to the end of the last previously recorded tape file before continuing to record a new measurement.

Following execution of one of the above pushkey commands, the command can be reactivated simply by pressing the **Exec./Ent.** pushkey. At the same time it will automatically update the file numbers specified, recording the measurement in the next adjacent file, thus making it possible to record a second or third measurement etc., without having to enter the entire pushkey command each time. Any attempt to record data in a write- protected tape file, or one which is not write-protected but incompatible in size, will permanently interrupt the above sequence plus print an error message, e.g. `File not found` , `End of data` or `File substitution impossible due to file size` .

Tape File Substitution

Where it is required to delete a recorded measurement and substitute one from another tape or memory file, the file numbers of both the destination and source should be specified. With new 7400 Digital Cassette Recorders (from serial number 1091835) files containing measurements within the following groups may be substituted by another measurement file belonging to the same group:

Group 1: All spectrum types

Group 2: 1 K time function

Group 3: 10 K time function

Group 4: Settings

Measurement files may also be substituted with earlier 7400 Recorders (whose serial numbers are less than 1091835). For this purpose the Recorders must be fitted with the File Substitution Option WH 1561 or the Clock Option WH 1559.

Move to 7400 Pushkey sequences

The pushkey sequences illustrated above can also be illustrated by a chart where each individual sequence can be traced from left to right. Fig 4.9 shows all usable pushkey sequences starting with **7400.** Any path from left to right represents a valid pushkey sequence and, depending upon which sequence is traced, will determine what operations if any will be performed on the stored data. Pushkeys are itemised by the characters in square brackets and correspond either with what appears on the pushkey itself or just above it. The **X** and **Y** refer to file numbers used for Tape, Volatile or Continuous memories.

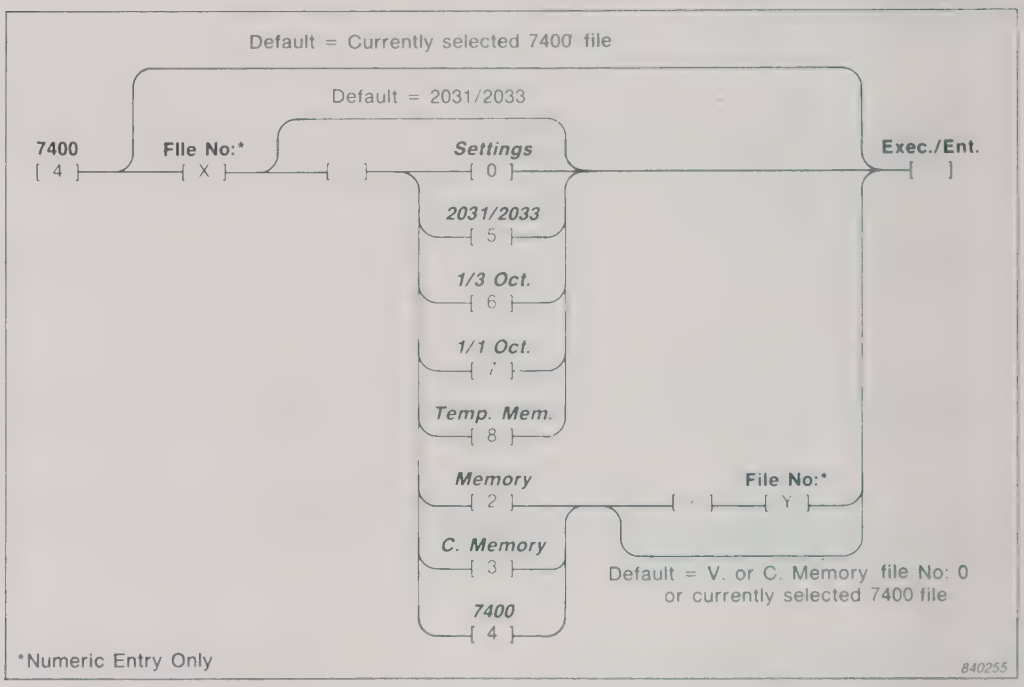


*Fig. 4.9. Chart for all usable pushkey sequences beginning with **7400***

4.2.6. Move to 2033 (2031) [5] – Function No: 5

The **Move to 2033 (or 2031)** function permits stored spectral and time domain data to be displayed on the screen of the Analyzer as well as reinstating the externally controllable Analyzer pushkey settings under which the measurements were originally made. Following display of a measurement, the Analyzer can be returned to normal operation by pressing either the **System Reset** pushkey or the DISPLAY SELECTOR "Input Function" pushkey if a spectrum is displayed or the RECORD "Cont." pushkey if a time domain signal is displayed.

The data types intended for use with the **Move to 2033 (or 2031)** function are as follows:

Spectrum	400 line (Baseband)
	High Resolution (2033 only)
	Averaged
	Ref. Spectrum (stored in Analyzer Memory)
	Spectrum difference (2313 Function)
	Spectrum Ratio (I/M 2033, I–M 2031)

Time Function	10 K (2033 only) 1 K
Constant Percentage Bandwidth	1/3 octave, 1/1 octave
Differentiation	Single and double
Integration	Single and double

Operating Set-Up Parameters

Provision is made for choosing whether or not the externally controllable pushkey settings of the Analyzer should be reinstated when displaying a measurement. This can be done by selecting **YES** or **NO** in the operating Set-Up as shown.

```
   FUNCTION          PARAMETER                    VALUE      UNIT
 5 2033            1 Move stored settings     : YES
```

The default case is **YES** meaning that the Analyzer settings are reinstated. See section 3.9.4. for changing to **NO** i.e. not reinstating the Analyzer settings.

The following points should be noted when transmitting measurements to the display screen of the Analyzer.

The spectral display on the screen of the Analyzer will always be RMS even if a non-RMS spectrum, i.e. PWR (Power), PSD (Power Spectral Density) or ESD (Energy Spectral Density), see section 4.2.33., is transmitted to the screen.

When a 1/3 Octave (see section 4.2.16.) or 1/1 Octave Band (see section 4.2.17) spectrum is transmitted to the screen of the Analyzer, the frequency given in the textline at the top of the screen will be incorrect, however the given level will be correct.

Spectra for integrated (see section 4.2.18.) and differentiated (see section 4.2.19.) time signals will have an extended dynamic range. To ensure that this fits on the display screen, a re-scaling is used which means that the level given on the textline will be incorrect, however the given frequency will be correct.

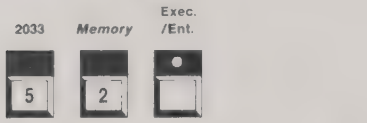
To obtain correct level and frequency of the processed data it is recommended that a plot be made of the contents of the ***Temp. Mem.*** instead of ***2033 (2031).***

Basic Pushkey Commands

In the following all commands are for the 2033 Analyzer, hence they contain the term **2033** at least once. The commands are equally valid for the 2031 Analyzer where the term **2031** should be substituted for **2033.** All command results are displayed on the screen of the Analyzer

Displays difference between spectra stored in V. Memory file X and file Y i.e. X–Y.

Displays contents of Temp. Mem.



Displays contents of V. Memory file 0.

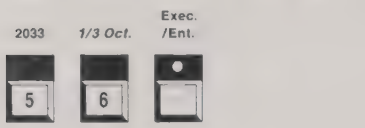
Displays contents of V. Memory file X.

Displays contents of C. Memory file 0.

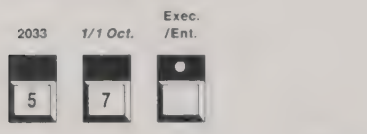
Displays contents of C. Memory file X.

Displays contents of Currently selected 7400 tape file.

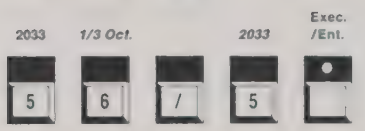
Displays contents of 7400 tape file X.



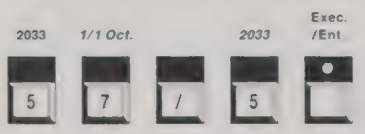
Displays 1/3 octave band spectrum derived from narrow band data.



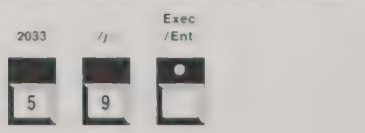
Displays 1/1 octave band spectrum derived from narrow band data.



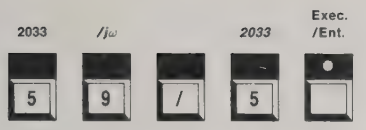
Displays 1/3 octave band spectrum derived from narrow band data.



Displays 1/1 octave band spectrum derived from narrow band data.



Time integrates signal of displayed spectrum.

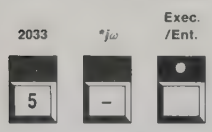


Time integrates signal of displayed spectrum.

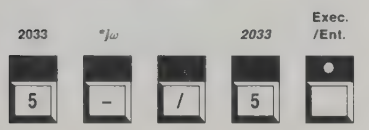
Time integrates signal of spectrum stored in V. Memory file X.

Time integrates signal of spectrum stored in C. Memory file X.

Time integrates signal of spectrum stored on 7400 tape file X.



Time differentiates signal of displayed spectrum.



Time differentiates signal of displayed spectrum.

Time differentiates signal of spectrum stored in V. Memory file X.

Time differentiates signal of spectrum stored in C. Memory file X.

Time differentiates signal of spectrum stored on 7400 tape file X.

where X and Y can be any integer number from 0 to 31 999 for 2313 Volatile and Continuous Memories and 1 to the highest used 7400 tape file number.

Move to 2033 (2031) Pushkey sequences

The pushkey sequences illustrated above can also be illustrated by a chart where each individual sequence can be traced from left to right. Fig 4.10 shows all usable pushkey sequences starting with **2033 (2031).** Any path from left to right represents a valid pushkey sequence and, depending upon which sequence is traced, will determine what operations if any will be performed on the displayed data. Pushkeys are itemised by the characters in square brackets and correspond either with what appears on the pushkey itself or just above it. The **X** and **Y** refer to file numbers used for Tape, Volatile or Continuous memories.

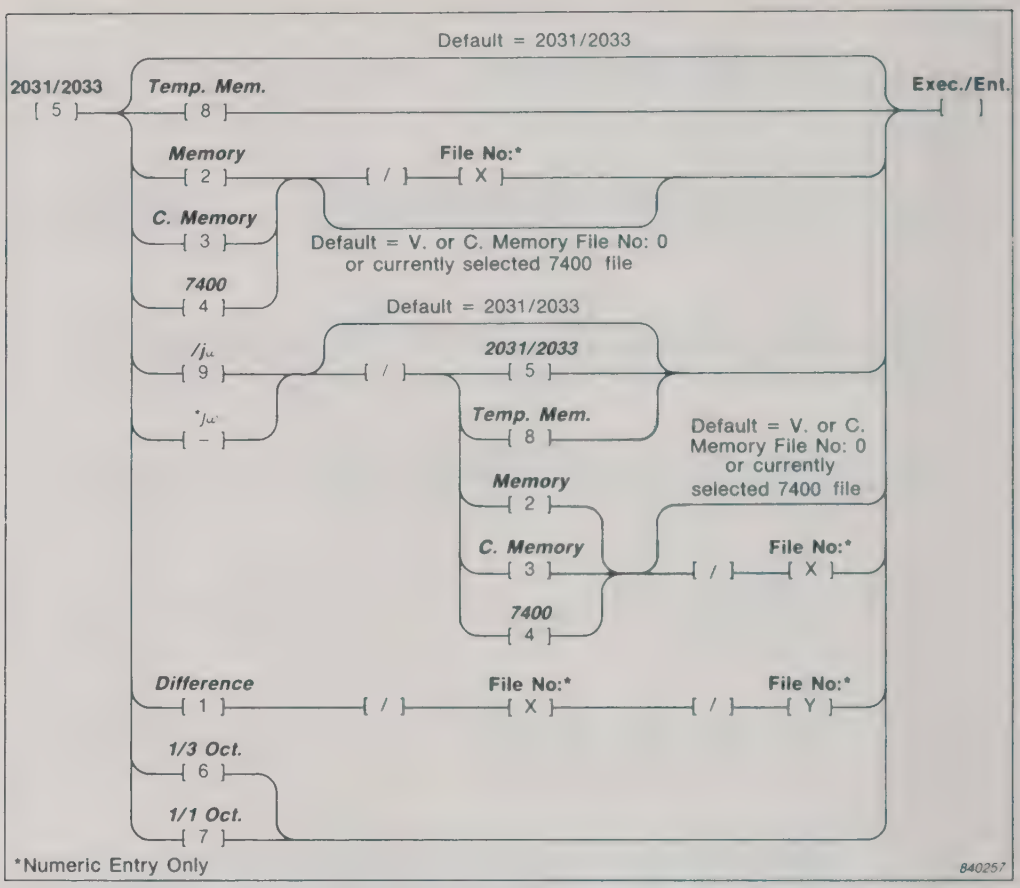


*Fig. 4.10. Chart for all usable pushkey sequences beginning with **2033***

4.2.7. Delete [6] – Function No: 6

The **Delete** Function is provided for deleting memory and tape files. It can be used to delete particular Volatile and Continuous Memory files as well as deleting the entire contents of one side of a 7400 tape file cassette. Memory type as well as file number or file number interval have to be specified. If a "–"sign is used in the delete command then all files, apart from those which are delete secured, will be deleted.

Note that part of the 2313 Volatile Memory which is used for storing files is also used for building up the plot diagrams when the **Plot** function is used. If there are many files stored in the Volatile Memory of the 2313 then the plot function will take place in more steps than for when there are fewer files stored. For this reason it is recommended that unimportant files stored in the Volatile Memory of the 2313 be deleted in order to speed up the **Plot** function.

The data types intended for use with the **Delete** function are as follows:

Spectrum	400 line (Baseband)
	High Resolution (2033 only)
	Averaged
	Ref. Spectrum (stored in Analyzer Memory)
	Spectrum difference (2313 Function)
	Spectrum Ratio (I/M 2033, I–M 2031)

Time Function	10 K (2033 only) 1 K
Constant Percentage Bandwidth	1/3 octave, 1/1 octave
Differentiation	Single and double
Integration	Single and double
Spectrum Conversion	Power Power Spectral Density Energy Spectral Density

Operating Set-Up Parameters

For securing single and consecutive Volatile and Continuous Memory files against deletion, operating Set-Ups 1, 2 and 3 are provided with the following control parameters

FUNCTION	PARAMETER		VALUE	UNIT
6 Delete	1 Memory secured	:	-1	-1
6 Delete	2 Contin. memory secured	:	-1	-1

The default case is -1 meaning that there is no protection against deletion. Protection against deletion is afforded by setting up the first and last file numbers of the range of files to be protected instead of the two -1's. In the case of a single file requiring protection against deletion the file number should be set up twice. See section 3.9.4. for setting up details. It is important to note that delete protection does not preclude over writing.

With regard to measurements stored in the Temporary Memory of the 2313 and on tape with the 7400, accidental deletion of data is not normally possible. This is because the data source has to be specified in order to execute delete. Also tape recorded data can be write protected against deletion or over recording by folding back or removing the safety tabs on the rear of the tape cassette.

Basic Pushkey Commands

The pushkey commands used for deleting non-delete secured or write-protected files are as follows:

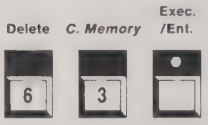
Deletes contents of Temp. Mem.

Deletes contents of V. Memory file 0

Deletes contents of V. Memory file X.

Deletes contents of all V. Memory files from X to Y.

Deletes all V. Memory files



Deletes C. Memory file 0.

Deletes C. Memory file X.

Deletes all C. Memory files from X to Y.

Deletes all C. Memory files.

Deletes all 7400 files.

where X and Y can be assigned any memory file number from 0 to 31 999.

Delete Pushkey sequences

The pushkey sequences illustrated above can also be illustrated by a chart where each individual sequence can be traced from left to right. Fig 4.11 shows all usable pushkey sequences starting with **Delete.** Any path from left to right represents a valid pushkey sequence and, depending upon which sequence is traced, will determine which files will be deleted. Pushkeys are itemised by the characters in square brackets and correspond either with what appears on the pushkey itself or just above it. The **X** and **Y** refer to file numbers used for Tape, Volatile or Continuous memories.

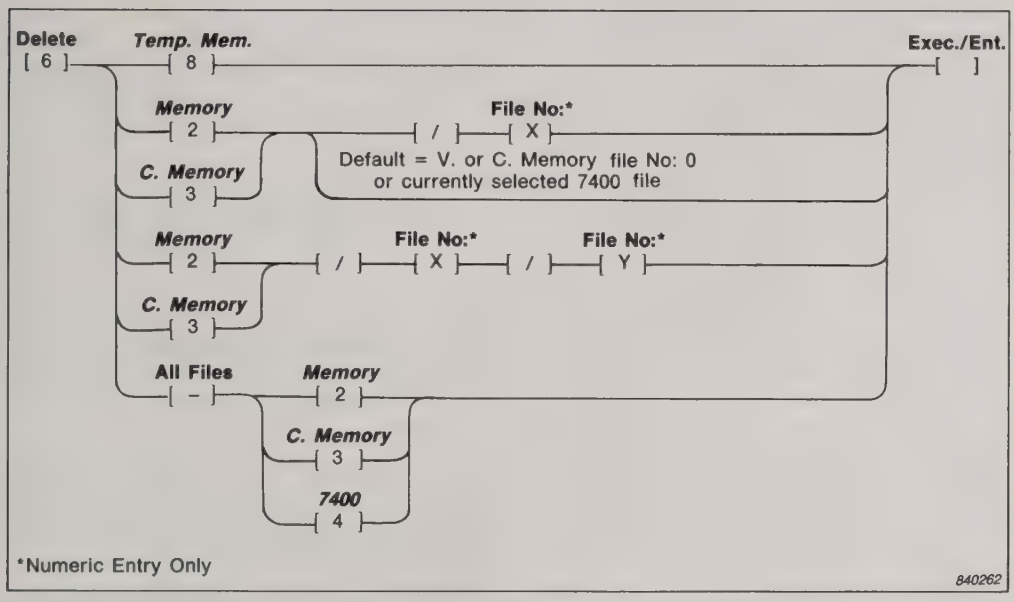


Fig. 4.11. Chart for all usable pushkey sequences beginning with ***Delete***

4.2.8. Memory Menu [7] – Function No: [7].

This function itemises the contents of memory and tape files utilized for storing measurements. Besides specifying file number, date and time of storage, plus type of measurement as shown in Fig. 4.12 it prints `DS` or `SS` alongside those memory files which are delete- or store-secured or both (see sections 4.2.3 and 4.2.7.) Where tape files not recorded with the aid of the BZ 7002/3 Application Packgages are encountered `Not a BZ7002 file` or `Not a BZ7003 file` will be printed by the Recorder.

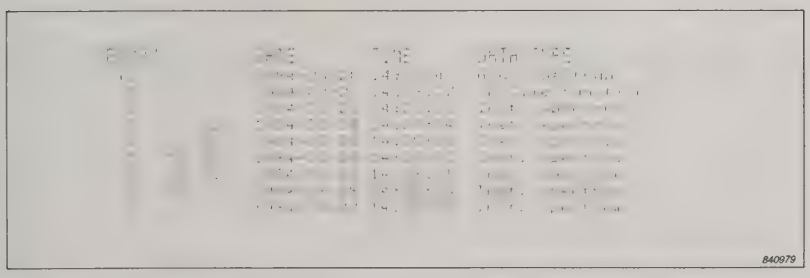


Fig. 4.12. Typical Memory Menu of Measurements stored in the Volatile Memory of the 2313

The data types intended for use with the **Memory Menu** function are as follows:

Spectrum	400 line (Baseband)
	High Resolution (2033 only)
	Averaged
	Ref. Spectrum (stored in Analyzer Memory)
	Spectrum difference (2313 Function)
	Spectrum Ratio (I/M 2033, I–M 2031)

Time Function	10 K (2033 only) 1 K
Constant Percentage Bandwidth	1/3 octave, 1/1 octave
Differentiation	Single and double
Integration	Single and double
Spectrum Conversion	Power Power Spectral Density Energy Spectral Density

Basic Pushkey Commands.

The pushkey commands for itemising stored data with the **Memory Menu** function are as follows:

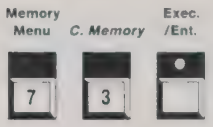
Itemises contents of Temp. Mem.

Itemises contents of Temp. Mem.

Itemises contents of all V. Memory files.

Itemises contents of V. Memory file X.

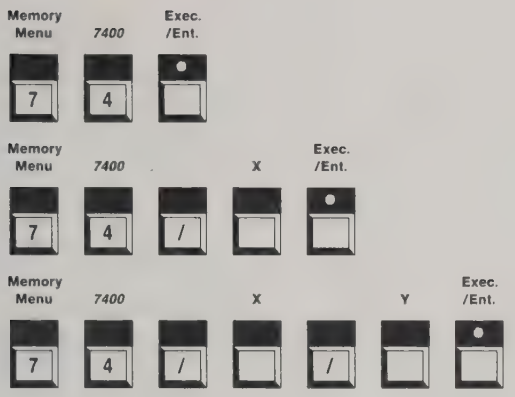
Itemises contents of all V. Memory files from X to Y.



Itemises contents of all C. Memory files.

Itemises contents of C. Memory file X.

Itemises contents of all C. Memory files from X to Y.



Itemises contents of all 7400 tape files.

Itemises contents of 7400 tape file X.

Itemises contents of all 7400 tape files from X to Y.

where X and Y can be assigned any memory file number from 0 to 31 999 and 1 to the highest used 7400 tape file number. Memory files are itemised in chronological order and tape files are itemised in numerical order. Where a 7400 soft-function is used then this is itemised according to its title when determining the menus of tape and volatile memories.

Memory Menu Pushkey sequences

The pushkey sequences illustrated above can also be illustrated by a chart where each individual sequence can be traced from left to right. Fig 4.13 shows all usable pushkey sequences starting with **Memory Menu.** Any path from left to right represents a valid pushkey sequence and, depending upon which sequence is traced, will determine which files will be itemised. Pushkeys are itemised by the characters in square brackets and correspond either with what appears on the pushkey itself or just above it. The **X** and **Y** refer to file numbers used for Tape, Volatile or Continuous memories.

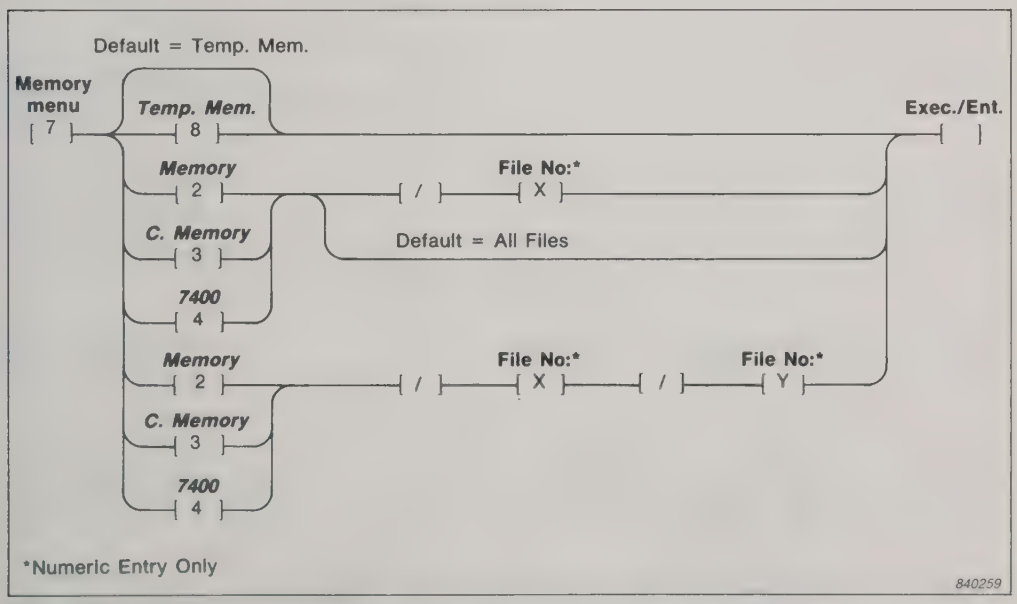


Fig. 4.13. Chart for all usable pushkey sequences beginning with ***Memory Menu***

4.2.9. Move to Temp. Mem. [8] – Function No: 8

The Temporary Memory implicitly stores the result of the latest operation carried out on the 2313 and can always be referred to **before** proceeding with a new operation. The Temporary Memory occupies a special file in the Volatile Memory therefore retaining its contents for as long as the 2313 is powered. Measurement data can also be explicitly stored in the Temporary Memory.

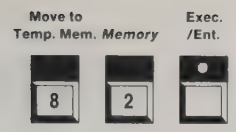
One advantage of the Temporary Memory is in carrying out a double integration (see section 4.2.17.) or differentiation (see section 4.2.18) on a signal whose spectrum is stored in the Temporary Memory or elsewhere or displayed on the screen of the Analyzer. This can be done by first integrating/differentiating a signal whose spectrum is stored in the Temporary Memory or elsewhere or on display and then performing a further integration/differentiation on the Temporary Memory. The resulting spectrum can be obtained by plotting or listing the contents of the Temporary Memory. This is very useful for vibration analysis when deriving acceleration, velocity and displacement spectra.

The data types intended for use with the **Move to Temp. Mem.** function are as follows:

Spectrum	400 line (Baseband) High Resolution (2033 only) Averaged Ref. Spectrum (stored in Analyzer Memory) Spectrum difference (2313 Function) Spectrum Ratio (I/M 2033, I–M 2031)
Time Function	10 K (2033 only) 1 K
Constant Percentage Bandwidth	1/3 octave, 1/1 octave
Differentiation	Single and double
Integration	Single and double

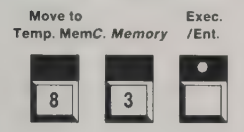
Basic Pushkey Commands

The basic pushkey commands for storing data in Temp. Mem. and/or performing operations on the measurement data are as follows:



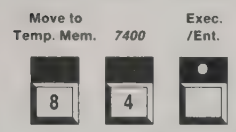
Stores in Temp. Mem. V. Memory file 0.

Stores in Temp. Mem. V. Memory file X.



Stores in Temp. Mem. C. Memory file 0.

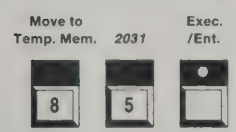
Stores in Temp. Mem. C. Memory file X.



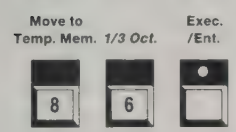
Stores in Temp. Mem. Current 7400 file.

Stores in Temp. Mem. 7400 tape file X.

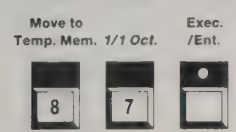
Stores in Temp. Mem. Analyzer display data.



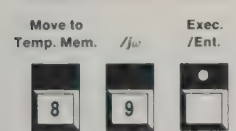
Stores in Temp. Mem. Analyzer display data.



Stores in Temp. Mem. 1/3 octave band data of displayed spectrum.



Stores in Temp. Mem. 1/1 octave band data of displayed spectrum.



Stores in Temp. Mem. result of time integrated signal of displayed spectrum.

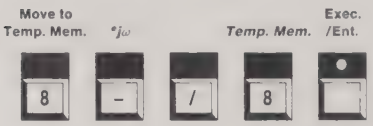
Time integrates signal whose spectrum is stored in Temp. Mem.

Stores in Temp. Mem. result of time integrated signal whose spectrum is stored in V. Memory file X.

Stores in Temp. Mem. result of time integrated signal whose spectrum is stored in C. Memory file X.

Stores in Temp. Mem. result of time integrated signal whose spectrum is stored on 7400 tape file X.

Stores in Temp. Mem. result of time differentiated signal of displayed spectrum.



Time differentiates signal whose spectrum is stored in Temp. Mem.

Stores in Temp. Mem. result of time differentiated signal whose spectrum is stored in V. Memory file X.

Stores in Temp. Mem. result of time differentiated signal whose spectrum is stored in C. Memory file X.

Stores in Temp. Mem. result of time differentiated signal whose spectrum is stored on 7400 tape file X.

where X and Y can be assigned any memory file number from 0 to 31 999 and 1 to the highest used 7400 tape file number.

Move to Temp. Mem. Pushkey sequences

The pushkey sequences illustrated above can also be illustrated by a chart where each individual sequence can be traced from left to right. Fig 4.14 shows all usable pushkey sequences starting with **Temp. Mem.** Any path from left to right represents a valid pushkey sequence and, depending upon which sequence is traced, will determine which operations if any will be performed on the stored data. Pushkeys are itemised by the characters in square brackets and correspond either with what appears on the pushkey itself or just above it. The **X** and **Y** refer to file numbers used for Tape, Volatile or Continuous memories.

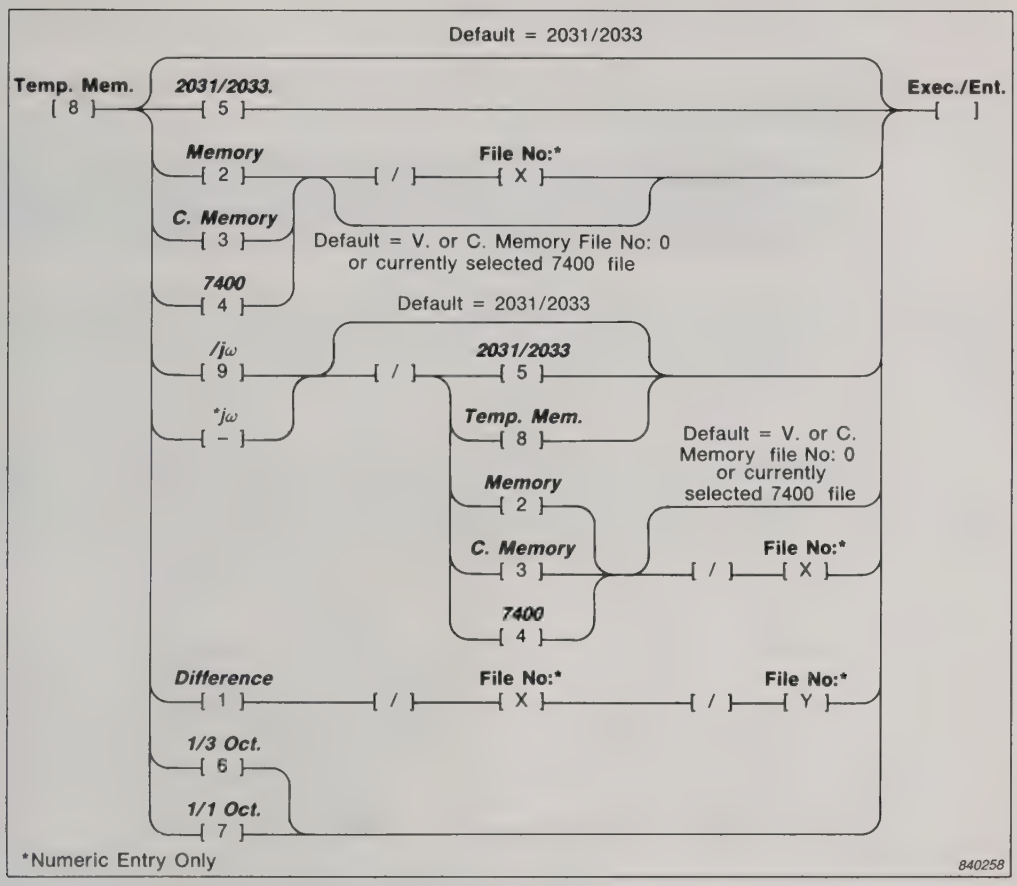


Fig. 4.14. Chart for all usable pushkey sequences beginning with ***Temp. Mem.***

4.2.10. Record Spectra [9] – Function No: 9

This function permits a series of spectra to be recorded automatically in a set of contiguous memory or tape files. The recording of spectra can be initiated in one of two ways. The first of these makes use of the trigger function of the Analyzer and the second uses preselected time intervals. The decision as to which method of initiation is to be used is made by the user via the operating Set-Up.

The data types intended for use with the **Record Spectra** function are as follows:

Spectrum	400 line (Baseband)
	High Resolution (2033 only)
	Averaged
	Ref. Spectrum (stored in Analyzer Memory)
	Spectrum Ratio (I/M 2033, I–M 2031)

Operating Set-Up Parameters

The operating Set-Ups available with the **Record Spectra** function are shown below and are for the default case.

FUNCTION	PARAMETER		VALUE	UNIT
9 Record spectra	1 Control	:	Time	
9 Record spectra	2 Time between spectra	:	1	s

1-Control Two possibilities exist for initiating the **Record Spectra** function. The default case is the one shown above i.e. **Time.** The other one is **Trigger** which can be obtained by pressing the **Yes** pushkey at the appropiate level of the Set-Up procedure. See section 3.9.4.

If **Time** is selected then the user may decide what interval there must be between successive spectra. This can be done by first selecting whether the interval shall be measured in seconds or minutes by pressing the **Yes** pushkey at the appropiate Set-Up level, see section 3.9.4. When this has been decided then the numerical value, i.e. from 1 to 1000 (whole numbers only) may be entered.

Trigger Control

The settings of the Analyzer will influence how the spectra will be read into the files of the 2313 or the 7400.

INPUT FUNCTION	"Averaged"
AVERAGING	"Lin"

Each time the Analyzer is triggered the "No. of Spectra" count is increased by one until the preset number is reached whereupon the linear average is calculated by the Analyzer and read and filed into the 2313 or the 7400. If the Analyzer is overloaded at any stage during this procedure then the associated spectra are excluded from the "No. of Spectra" count, this can be verified by taking a plot of the relevant file and noting when "Averaging stopped", the difference between the "Averaging stopped" count and the "No. of Spectra" count represents the number of excluded (overloaded) spectra. This process continues until all preselected files are used up.

INPUT FUNCTION	"Averaged"
AVERAGING	"Exp." or "Hold Max"

Each time the Analyzer is triggered a spectrum is read and filed into the 2313 or the 7400. This process continues until all preselected files are used up.

TRIGGER	"Free Run"

The INPUT FUNCTION on the Analyzer is set to "Averaged Spectrum" and the "Number of Spectra" count is set to "1". A spectrum is filed each time a new 1 K time record is captured by the Analyzer (however speed is limited by how fast spectra can be calculated and transferred to either the 7400 or the 2313). This ensures that each spectrum is based on a freshly recorded 1 K time function. It should be noted that the lower the frequency range of the Analyzer the longer it will take to capture a fresh 1 K time record.

Time Control

The settings of the Analyzer will influence how the spectra will be read into the files of the 2313 or the 7400. It should be noted that the 7400 requires an extra 6 to 9 seconds over and above the preset time interval to make a recording of a spectrum.

INPUT FUNCTION	"Averaged"
AVERAGING	"Lin"

Fig. 4.15 indicates what events take place and when they occur. The whole sequence is initiated at time t_0 which is when the "Execute" pushkey is pressed. After a brief period, used for allocating space in the memory for files, the first cycle begins at t_1 when the command "Start Averaging" is given to the Analyzer. When averaging finishes, a brief interval of time is used for reading and filing the first averaged spectrum, after this the system waits until the beginning of the second cycle at $t_1 + T$ whereupon the cycle repeats itself. This process continues until all allocated files are used up. A point to remember is that a realistic time interval must be set in order to give the Analyzer time to perform its averaging. If the time to make a linear average is longer than the preselected time interval then the spectra will be read into 2313 or 7400 files at a rate decided by the averaging process.

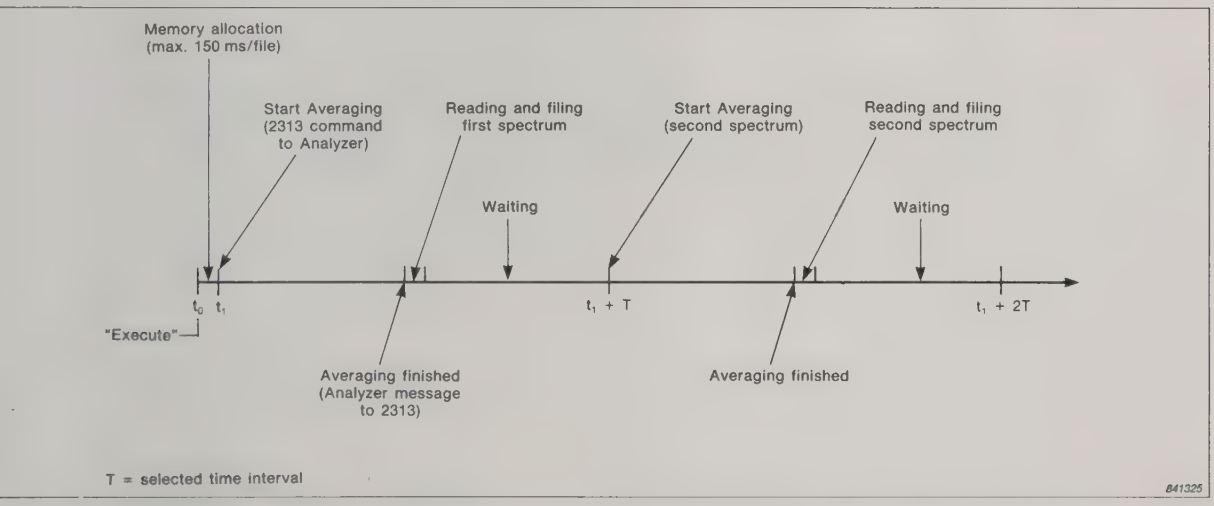


Fig. 4.15. Sequence of events for the function ***Record Spectra****, Set-Up set to* ***time*** *and the Analyzer settings INPUT FUNCTION and AVERAGING set to "Averaged" and "Lin." respectively*

INPUT FUNCTION	"Averaged"
AVERAGING	"Hold Max"

Fig. 4.16 indicates what events take place and when they occur. The whole sequence is initiated at time t_0 which is when the "Execute" pushkey is pressed. After a brief period, used for allocating space in the memory for files, the first cycle begins at t_1 which is when the command "Start Averaging" is given to the Analyzer in order to clear its buffer. From this point onwards the maximum level occurring in each of the 400 lines of the Analyzer over the remainder of the cycle (which is terminated by the command "Stop Averaging" at $t_1 + T$) is detected and held. Between $t_1 + T$ and t_2 the resulting spectrum

is read and filed. At t_2 the second cycle starts. This process continues until all allocated files are used up.

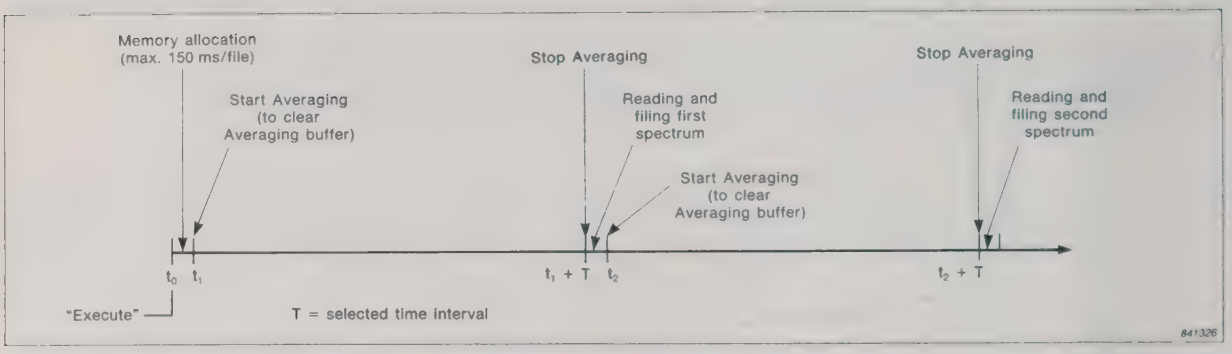


*Fig. 4.16. Sequence of events for the function **Record Spectra**, Set-Up set to **time** and the Analyzer settings INPUT FUNCTION and AVERAGING set to "Averaged" and "Hold Max." respectively*

INPUT FUNCTION	"Averaged"
AVERAGING	"Exp"

Fig. 4.17 indicates what events take place and when they occur. The whole sequence is initiated at time t_0 which is when the "Execute" pushkey is pressed. After a brief period, used for allocating space in the memory for files, the first cycle begins at t_1 which is when the command "Start Averaging" is given to the Analyzer. Between $t_1 + T$ and t_2 a spectrum is read and filed. At t_2 the second cycle starts. This process continues until all allocated files are used up.

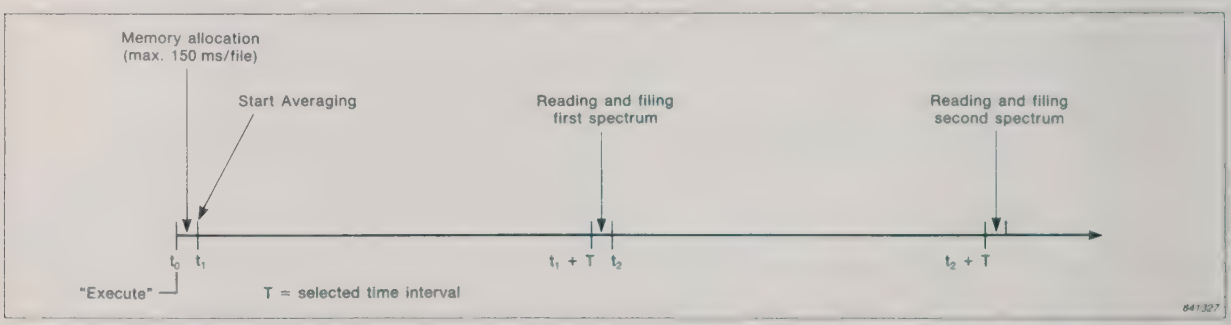


*Fig. 4.17. Sequence of events for the function **Record Spectra**, Set-Up set to **time** and the Analyzer settings INPUT FUNCTION and AVERAGING set to "Averaged" and "Exp." respectively*

Basic Pushkey Commands

The basic pushkey commands for Storing Spectra in Volatile, Continuous and 7400 Tape files are as follows:

Stores spectra from Analyzer in contiguous V. Memory Files X to Y

Stores spectra from Analyzer in contiguous C. Memory Files X to Y

Stores spectra from Analyzer in contiguous 7400 Tape Files X to Y

where X and Y can be assigned any memory file number from 0 to 31 999 and 1 to the highest used 7400 tape file number.

Record Spectra Pushkey sequences

The pushkey sequences illustrated above can also be illustrated by a chart where each individual sequence can be traced from left to right. Fig 4.18 shows all usable pushkey sequences starting with **Record Spectra**. Any path from left to right represents a valid pushkey sequence. Pushkeys are itemised by the characters in square brackets and correspond either with what appears on the pushkey itself or just above it. The **X** and **Y** refer to file numbers used for Tape, Volatile or Continuous memories.

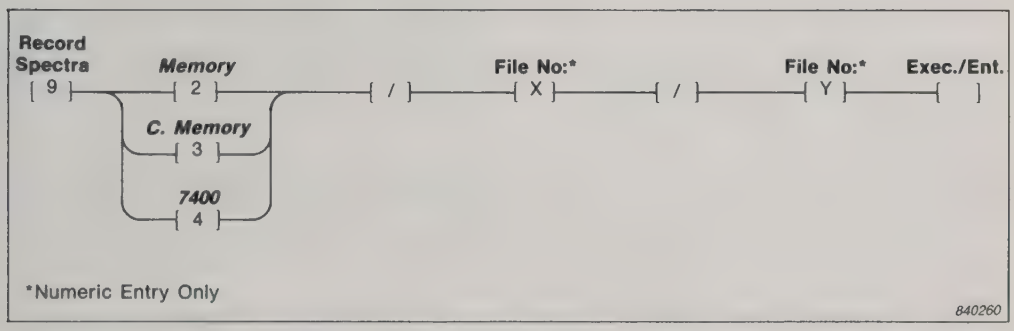


Fig. 4.18. Chart for all usable pushkey sequences beginning with ***Record Spectra***

4.2.11. Plot Av. Spectra [10] – Function No: 10

The **Plot Av. Spectra** enables the 2313 to perform certain statistical calculations on a set of contiguous files containing spectra covering the same frequency range. The quantities calculated are presented graphically and a choice of what quantities are to be plotted is made available via the Set-Up.

The basic calculation is the average, or mean, spectrum of the filed spectra. To this can be added, in the form of extra curves, the mean plus and minus the standard deviation

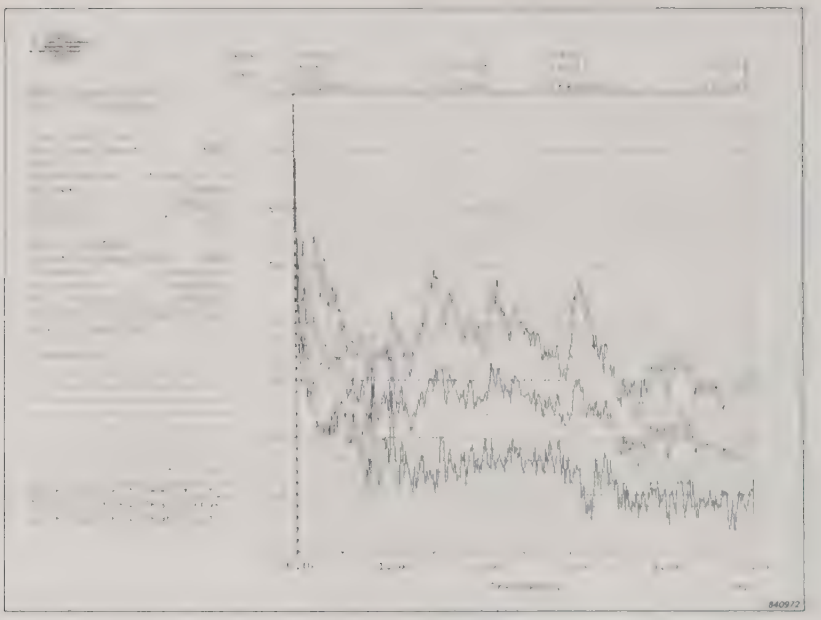


Fig. 4.19. Plot of mean spectrum showing extra curves

(σ), or the mean plus and minus twice the standard deviation (2 σ), or the maximum and minimum. The plots are fully annotated, see Fig. 4.19, so it is possible to see immediately what the extra curves represent.

There are two forms of averaging available, these are known as Logarithmic and Arithmetical and can be selected by pressing the **Yes** pushkey at the appropiate Set-Up level. The Logarithmic is the simpler whereby all data used are the decibel values of the spectra i.e. the average value of 100 dB and 90 dB is 95 dB. The same approach is taken for calculating the standard deviation. The Arithmetical approach performs the same calculations but instead of using the straight dB values it uses the antilog of one tenth of the dB values, thus the average of 100 dB and 90 dB is calculated according to the following expression:

$$10 \log_{10}\left[\left(10^{\frac{100}{10}} + 10^{\frac{90}{10}}\right)/2\right] = 97{,}4 \text{ dB}$$

The data types intended for use with the **Plot Av. Spectra** function are as follows:

Spectrum	400 line (Baseband)
	High Resolution (2033 only)
	Averaged
	Ref. Spectrum (stored in Analyzer Memory)
	Spectrum Ratio (I/M 2033, I–M 2031)

Operating Set-Up Parameters

The operating Set-Ups available with the **Plot Av. Spectra** function are shown below and are for the default case

FUNCTION	PARAMETER	VALUE	UNIT
10 Plot av. spectra	1 Extra curves	: None	
10 Plot av. spectra	2 Averaging	: Arithmetical	

1-Extra curves Four possibilities exist including the default case shown above. The other three are obtainable by pressing the **Yes** pushkey at the appropiate level of the Set-Up procedure, see section 3.9.4. The extra curves plotted by the other three are (i) **Mean +/– σ**, (ii) **Mean +/– 2σ** and (iii) **Min. and max.** where σ is the standard deviation of the set of contiguous spectra.

2-Averaging Two possibilities exist including the default case shown above. The other, i.e. **Logarithmic**, is obtained by pressing the **Yes** pushkey at the appropriate level of the Set-Up procedure, see section 3.9.4. A point to note when using the **Arithmetical** averaging is that if the standard deviation σ, or twice the standard deviation 2 σ as the case may be, is greater than the mean then this will lead to negative results which cannot be converted back to decibels. Instead they are assigned the value of –140 dB which is the absolute bottom value of the Analyzer range.

Basic Pushkey Commands

The basic pushkey commands for plotting average spectra are as follows:

Plots the mean spectrum of spectra stored in contiguous V. Memory Files X to Y

Plots the mean spectrum of spectra stored in contiguous C. Memory Files X to Y

Plots the mean spectrum of spectra stored in contiguous 7400 Tape Files X to Y

where X and Y can be assigned any memory file number from 0 to 31 999 and 1 to the highest used 7400 tape file number.

Plot Av. Spectra Pushkey sequences

The pushkey sequences illustrated above can also be illustrated by a chart where each individual sequence can be traced from left to right. Fig 4.20 shows all usable pushkey sequences starting with **Plot Av. Spectra.** Any path from left to right represents a valid pushkey sequence. Pushkeys are itemised by the characters in square brackets and correspond either with what appears on the pushkey itself or just above it. The **X** and **Y** refer to file numbers used for Tape, Volatile or Continuous memories.

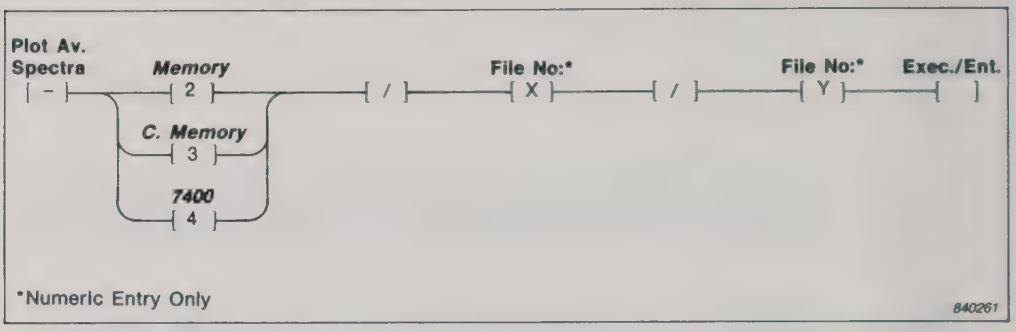


*Fig. 4.20. Chart for all usable pushkey sequences beginning with **Plot Av. Spectra***

4.2.12. Probability Density [/] [1] – Function No: 11

This function calculates and plots the amplitude probability density function of a time domain signal stored in Volatile Memory, Continuous Memory or on a 7400 tape file. In addition it will perform similar calculations and plots for a time domain signal or a series of time domain signals displayed on the Analyzer. The quantities calculated are **mean** and **variance** (σ^2) together with an indication (optional) on the plot of where the mean and standard deviation (σ) are located, see Fig.4.21.

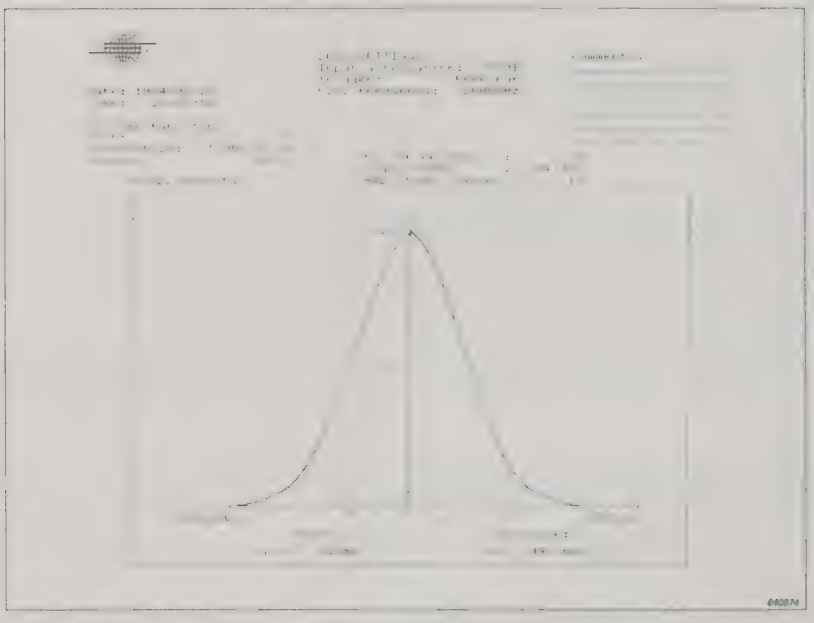


Fig. 4.21. Plot of probability density function showing location of σ and mean

The data types intended for use with the **Probability Density** function are as follows:

Time Function	10 K (2033 only), 1 K

Operating Set-Up Parameters

The operating Set–Up parameters for the **Probability Density** function are shown below and are for the default case.

	FUNCTION	PARAMETER		VALUE	UNIT
(/ 1) 11	Prob. density	1 Amplitude classes	:	100	
(/ 1) 11	Prob. density	2 Suppress σ - marks	:	NO	
(/ 1) 11	Prob. density	3 Number of records	:	1	

1-Amplitude Classes: Accepts values from 10 to 100 (whole numbers only). It fixes the number of class intervals between the zero line and the "Full Scale Level" of a time domain display. Through symmetry the same number of class intervals apply on the negative side of the zero line.

2-Suppress σ–marks: Accepts **Yes** or **No** pushkey depending on whether **σ–marks** (standard deviation marks) are to be included on the probability density plots. It also decides whether or not the location of the mean will appear on the plot.

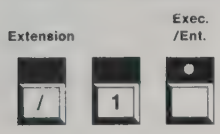
3-Number of records: Accepts values from 1 to 1 000 (whole numbers only). Used when a continuous signal is applied to the Analyzer. The chosen number of time records appear one after the other on the screen of the Analyzer before being fed into the calculations for the probability density function plot.

Since the amplitude range is divided up into class intervals, the probability density function will be a series of discrete quantities. To ensure continuity these discrete quantities are joined together by a quadratic interpolation curve. The area under the probability density curve will always be unity therefore the units of the vertical axis will be the reciprocal of the units of the horizontal axis.

The fully annotated probability density plots are furnished with information on the number of time records, the number of class intervals and the width of the class intervals in calibrated units.

Basic Pushkey Commands

The basic pushkey commands for producing probability density plots are as follows:

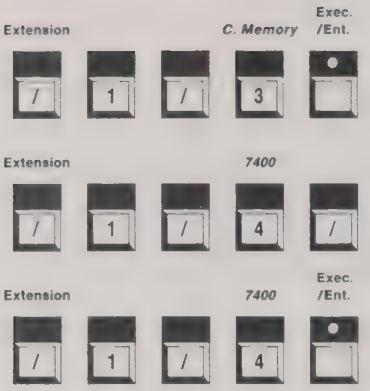


Plots probability density function of time function displayed on Analyzer

Plots probability density function of time function stored in V. Memory File X

Plots probability density function of time function stored in V. Memory File 0

Plots probability density function of time function stored in C. Memory File X



Plots probability density function of time function stored in C. Memory File 0

Plots probability density function of time function stored on 7400 Tape File X

Plots probability density function of time function stored on 7400 Tape File 0

where X and Y can be assigned any memory file number from 0 to 31 999 and 1 to the highest used 7400 tape file number.

Probability Density Pushkey sequences

The pushkey sequences illustrated above can also be illustrated by a chart where each individual sequence can be traced from left to right. Fig 4.22 shows all usable pushkey sequences starting with **[/] [1] (Probability Density).** Any path from left to right represents a valid pushkey sequence. Pushkeys are itemised by the characters in square brackets and correspond either with what appears on the pushkey itself or just above it. The **X** and **Y** refer to file numbers used for Tape, Volatile or Continuous memories.

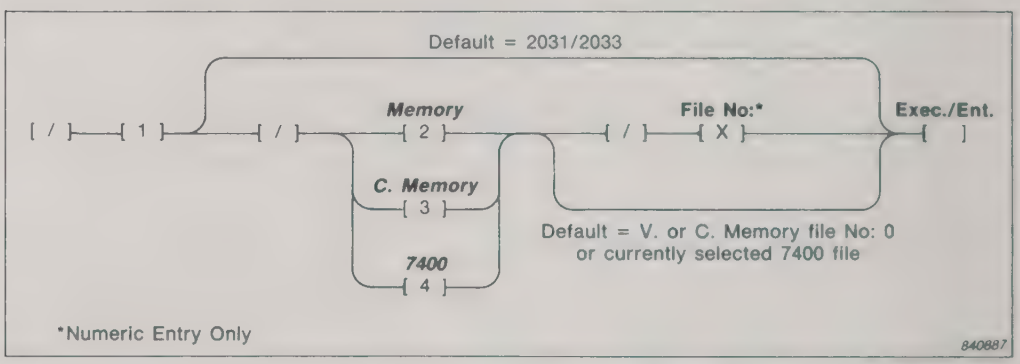


*Fig. 4.22. Chart for all usable pushkey sequences beginning with **[/] [1] (Probability Density)***

4.2.13. Probability Distribution [/] [2] – Function No: 12

This function calculates and plots the amplitude (cumulative) probability distribution function of a time domain signal stored in Volatile Memory, Continuous Memory or on a 7400 tape file. In addition it will perform similar calculations and plots for a time domain signal or a series of time domain signals displayed on the Analyzer. The quantities calculated are **mean** and **variance** (σ^2) together with an indication (optional) on the plot of where the mean and standard deviation (σ) are located, see Fig. 4.23.

Fig. 4.23. Plot of probability distribution function showing location of σ and mean

The data types intended for use with the **Probability Distribution** function are as follows:

Time Function	10 K (2033 only), 1 K

Operating Set-Up Parameters

The operating Set–Up parameters for the **Probability Distribution** function are shown below and are for the default case.

	FUNCTION	PARAMETER	VALUE	UNIT
(/ 2)	12 Prob. distribution	1 Amplitude classes	: 100	
(/ 2)	12 Prob. distribution	2 Suppress σ - marks	: NO	
(/ 2)	12 Prob. distribution	3 Number of records	: 1	

1-Amplitude Classes: Accepts values from 10 to 100 (whole numbers only). It fixes the number of class intervals between the zero line and the "Full Scale Level" of a time domain display. Through symmetry the same number of class intervals apply on the negative side of the zero line.

2- Suppress σ–marks: Accepts **Yes** or **No** pushkey depending on whether **σ–marks** (standard deviation marks) are to be included on the probability distribution plots. It also decides whether or not the location of the mean will appear on the plot.

3- Number of records: Accepts values from 1 to 1 000 (whole numbers only). Used when a continuous signal is applied to the Analyzer. The chosen number of time records appear one after the other on the screen of the Analyzer before being fed into the calculations for the probability distribution function plot.

Since the amplitude range is divided up into class intervals, the probability distribution function will be a series of discrete quantities. To ensure continuity these discrete quan-

tities are joined together by a quadratic interpolation curve. The units of the vertical axis are in percent and represent the probability of the time function being less than a given value (read off the horizontal axis).

The fully annotated probability distribution plots are furnished with information on the number of time records, the number of class intervals and the width of the class intervals in calibrated units.

Basic Pushkey Commands

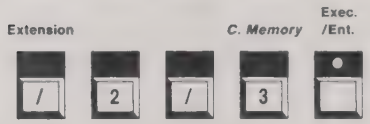
The basic pushkey commands for producing probability distribution plots are as follows:

Plots probability distribution function of time function displayed on Analyzer

Plots probability distribution function of time function stored in V. Memory File X

Plots probability distribution function of time function stored in V. Memory File 0

Plots probability distribution function of time function stored in C. Memory File X



Plots probability distribution function of time function stored in C. Memory File 0

Plots probability distribution function of time function stored on 7400 Tape File X

Plots probability distribution function of time function stored on 7400 Tape File 0

where X and Y can be assigned any memory file number from 0 to 31 999 and 1 to the highest used 7400 tape file number.

Probability Distribution Pushkey sequences

The pushkey sequences illustrated above can also be illustrated by a chart where each individual sequence can be traced from left to right. Fig 4.24 shows all usable pushkey sequences starting with **[/] [2] (Probability Distribution).** Any path from left to right represents a valid pushkey sequence. Pushkeys are itemised by the characters in square brackets and correspond either with what appears on the pushkey itself or just above it. The **X** and **Y** refer to file numbers used for Tape, Volatile or Continuous memories.

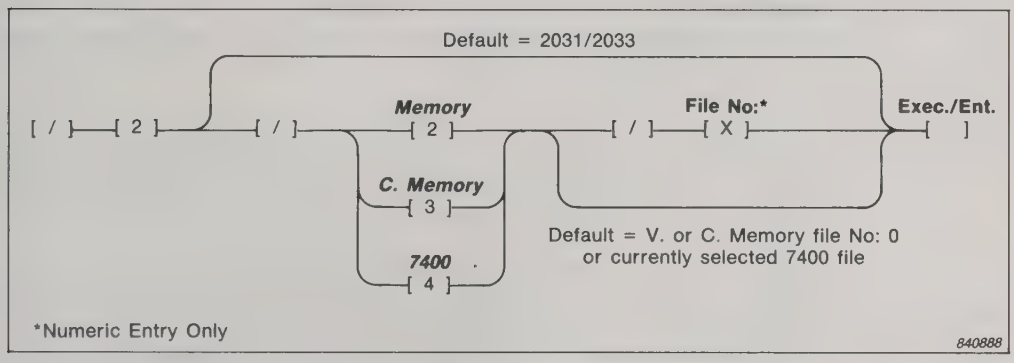


*Fig. 4.24. Chart for all usable pushkey sequences beginning with **[/] [2] (Probability Distribution)***

4.2.14. Settings [0] – Sub-Function No: 20

This is a sub-function which allows only the externally controllable Analyzer pushkey settings to be stored. The location of the stored settings is decided by the main function used with the ***Settings*** sub-function. The main functions that can be used with the ***Settings*** sub-function are **Move to Volatile Memory, Move to Continuous Memory, Move to 7400,** and **Move to Temp. Mem.** Pushkey sequences of each example are given in the sections dealing with the aforementioned main functions. This sub-function is useful for storing Analyzer settings which can be restored as a whole to the Analyzer instead of resetting individual pushkeys. It can be used as an alternative to the SYSTEM RESET pushkey on the Analyzer.

4.2.15. Difference [1] – Sub-Function No: 21

This is a sub-function which enables the difference between two spectra, stored in Volatile Memories, to be determined. The location of the result will depend upon which main function the ***Difference*** sub-function is used with. The main functions that can be used with the ***Difference*** sub-function are **List, Plot, Move to 2031/2033** and **Move to Temp. Mem.** Pushkey sequences of each example are given in the sections dealing with the aforementioned main functions.

The data types intended for use with the ***Difference*** sub-function are as follows:

Spectrum	400 line (Baseband)
	High Resolution (2033 only)

Operating Set-Up Parameters

The operating Set–Up parameters for the ***Difference*** sub-function are shown below and are for the default case.

FUNCTION	PARAMETER		VALUE	UNIT
21 Difference	1 Spectrum gain	:	0	dB
21 Difference	2 Calculation	:	Arithmetical	

1-Spectrum gain: Accepts values from –50 to 50 in steps of 10. Has precisely the same effect as the display gain pushkeys on the Analyzer. Is very useful because the result of a **Difference** (subtraction) between two source spectra can lie outside of the range of the two source spectra.

2-Calculation: Accepts either **Arithmetical** or **Logarithmic.** The default case, **Arithmetical,** is shown above. **Logarithmic** can be chosen by pressing the **Yes** pushkey at the appropriate level of the Set-Up procedure, see section 3.9.4.

For **Arithmetical** the **Difference** calculated is based on the amplitude difference between the two spectra. For RMS spectra the corresponding amplitude is given as the antilog of one twentieth of the decibel values: for Power (PWR), Power Spectral Density (PSD) and Energy Spectral Density (ESD) (see section 4.2.33.) the corresponding amplitudes are given as the antilog of one tenth of the decibel values. In all cases, however, the arithmetical difference of say 100 dB and 90 dB will be calculated as shown below:

$$10 \log_{10}\left[10^{\frac{100}{10}} - 10^{\frac{90}{10}} \right] = 99{,}5 \text{ dB}$$

Since amplitude differences which are negative cannot be converted to logarithmic (decibel) form the result is assigned the value of –140 dB which is the bottom value of the Analyzer range.

For **Logarithmic** the **Difference** is calculated as the straight decibel difference between the values of the two spectra e.g. the difference between 100 dB and 90 dB is 10 dB.

4.2.16. 1/3 Octave Band Spectrum [6] – Sub-Function No: 26

This is a sub-function which enables the synthesis of 1/3 octave band spectra, using preferred centre frequencies, to be carried out over three decades. In addition, the total energy (L) as well as the A-weighted energy are calculated. The lowest frequency in the 1/3 octave band plot is 1/1 000 of the full scale frequency setting on the Analyzer. The highest possible 1/3 octave band centre frequency will be 16 kHz whereas the lowest will be limited only by the Analyzer. Fig. 4.25 shows an example of a plot of 1/3 octave band data.

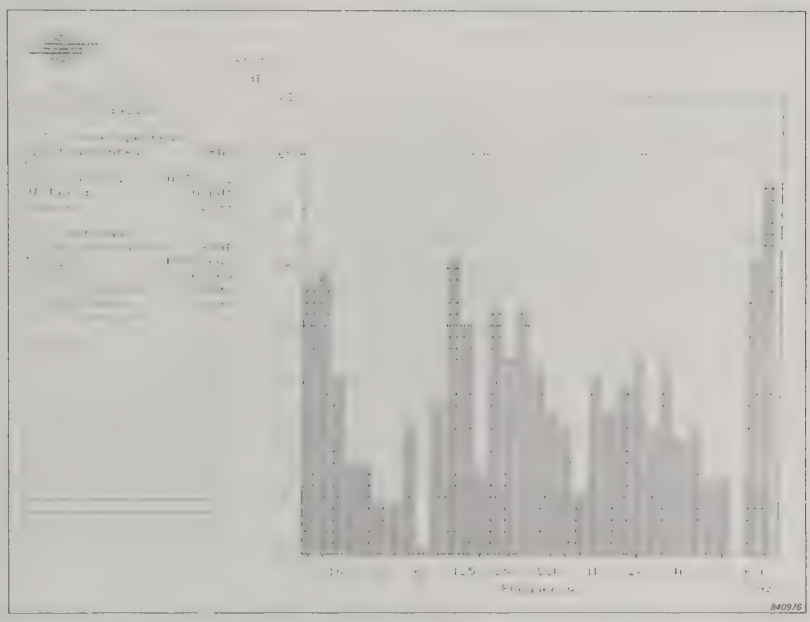


Fig. 4.25. Plot of 1/3 octave band spectrum

Two types of synthesis are carried out. The first requires that the signal applied to the Analyzer be stationary, the second enables a synthesis to be carried out on a transient signal (2033 only). The choice of which type of signal forms the basis of the synthesis is made via the Operating Set-Up Procedure (2033 only).

The main functions that can be used with the ***1/3 Oct.*** sub-function are **Plot, Move to Volatile Memory, Move to Cont. Mem, Move to 7400, Move to Temp. Mem.** and **Move to 2031/2033.** Pushkey sequences of each example are given in the sections dealing with the aforementioned main functions.

The data types intended for use with the ***1/3 Oct.*** sub-function are as follows:

Spectrum	400 line (Baseband) Averaged

Only data from the Analyzer can be used since it is reprogrammed during synthesis

Operating Set-Up Parameters (2033 only)

The operating Set-Up parameters for the ***1/3 Oct.*** sub-function are shown below and are for the default case.

FUNCTION	PARAMETER	VALUE	UNIT
26 1/3 oct. spectrum	1 Signal type	: Stationary	

1-Signal type: Can be either **stationary**, as shown above for the default case, or **transient** which can be chosen by pressing the **Yes** pushkey at the appropriate level of the Set-Up procedure, see section 3.9.4.

Stationary Signals

The synthesis is made in three passes of ascending frequency decades in order to increase the spectral line density within the 1/3 octave bands. The first pass is performed with the Analyzer set to 1/100 of its original full scale frequency setting. The Analyzer is then set one frequency decade up and a second pass is performed. Finally the Analyzer is set to the highest frequency (the original full scale frequency setting of the Analyzer) and a third and final pass is made. At this point the data from the three passes are combined to produce 1/3 octave band data covering three decades and will be presented at the place decided by the main function.

There are two methods of producing 1/3 octave band data from a stationary signal. The first is with the RECORD pushkey of the Analyzer set to "Stop" and the second is with it set to "Cont". In the first case one spectrum is taken for each pass as the basis of the synthesis. In the second case a number of spectra is linearly averaged and used as a basis for the synthesis, the number of spectra used is user definable and is decided by the NO OF SPECTRA setting on the Analyzer. An example of the filter response of a synthesised 1/3 octave band filter for stationary data is shown in Fig. 4.26. Filters with other centre frequencies are in fact better than the one shown in Fig. 4.26. In the example where the original Analyzer full scale frequency setting is 20 kHz, the filter shapes at 20, 200 and 2 000 Hz are identical. At all other frequencies the filter skirts will be steeper.

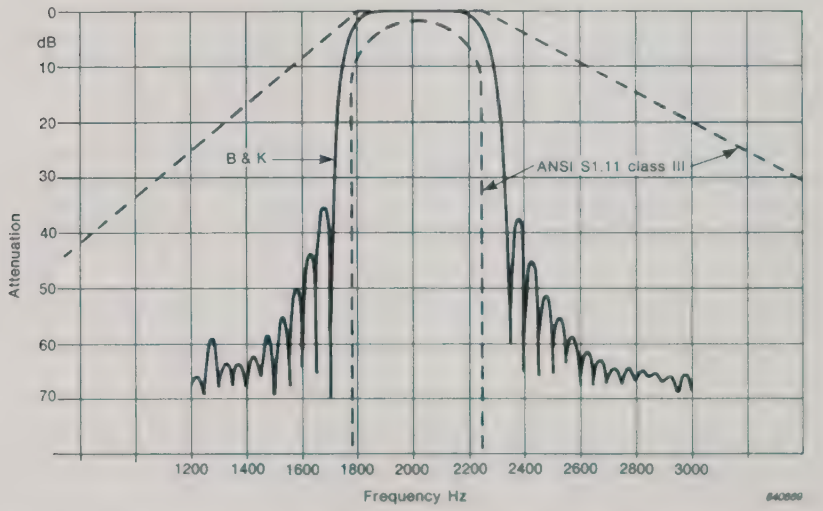


Fig. 4.26. Filter response for 1/3 octave band filters synthesised for stationary signals. Taken from synthesis with the Analyzer set to a full scale frequency of 20 kHz

Transient Signals (2033 only)

A prerequisite of synthesising 1/3 octave band data from a transient signal is that the transient is captured in the 10 K memory of the 2033. If this is not the case then the RECORD "Single" pushkey will be automatically activated by the process which then waits until a full recording of the signal is made, this will be denoted when the RECORD "Stop" pushkey is activated. At this point the ZOOM facility with the cursor set to line no. 20 (the mid frequency in the ZOOM display) is activated and 1/3 octave band data for the two lower frequency decades is synthesised. The 2033 is now reset to the original full scale frequency range and a Scan Average is performed with the NO OF SPECTRA set to 37, the reason for choosing 37 is explained in B & K Technical Review No. 2 1980. The Scan Averaged spectrum is subsequently used to synthesise the 1/3 octave bands for the upper frequency decade. At this point the 1/3 octave band data from all the decades is combined to give the final 1/3 octave band result which is presented at the place decided by the main function. An example of the filter response of a one third octave band synthesised for transient data is shown in Fig. 4.27. Filters with higher centre frequencies are in fact better than the one shown in Fig. 4.27.

For both types of synthesis the frequency limits for each 1/3 octave band are determined and the spectral lines lying within these limits are summed. Additionally the fractional contribution from spectral lines lying across the filter limits is added.

When a 1/3 octave band spectrum is displayed on the screen of the Analyzer the cursor may be used to read off the correct decibel levels.

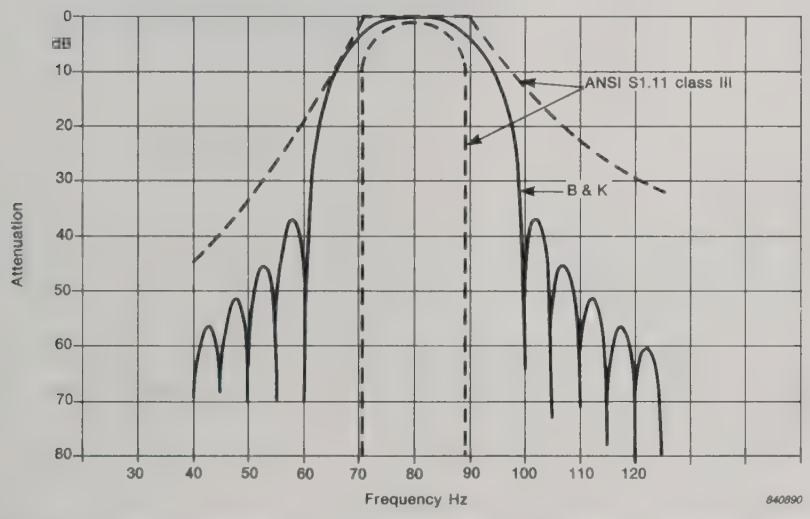


Fig. 4.27. Filter response for 1/3 octave band filters synthesised for transient signals. Taken from synthesis with the Analyzer set to a full scale frequency of 20 kHz

4.2.17. 1/1 Octave Band Spectrum [7] – Sub-Function No: 27

This is a sub-function which enables the synthesis of 1/1 octave band spectra, using preferred centre frequencies, to be carried out over three decades. In addition the total energy (L) as well as the A-weighted energy are calculated. Fig 4.28 shows an example of a plot of 1/1 octave band data.

Fig. 4.28. Plot of 1/1 octave band spectrum

Two types of synthesis are carried out. The first requires that the signal applied to the Analyzer be stationary, the second enables a synthesis to be carried out on a transient signal (2033 only). The choice of which type of signal forms the basis of the synthesis is made via the Operating Set-Up Procedure (2033 only).

The main functions that can be used with the ***1/1 Oct.*** sub-function are **Plot, Move to Volatile Memory, Move to Cont. Mem, Move to 7400, Move to Temp. Mem.** and **Move to 2031/2033.** Pushkey sequences of each example are given in the sections dealing with the aforementioned main functions.

The data types intended for use with the ***1/1 Oct.*** sub-function are as follows:

Spectrum	400 line (Baseband) Averaged

Only data from the Analyzer can be used since it is reprogrammed during synthesis

Operating Set-Up Parameters (2033 only)

The operating Set-Up parameters for the ***1/1 Oct.*** sub-function are shown below and are for the default case.

FUNCTION	PARAMETER	VALUE	UNIT
27 1/1 oct. spectrum	1 Signal type	: Stationary	

1-Signal type: Can be either **stationary**, as shown above for the default case, or **transient** which can be chosen by pressing the **Yes** pushkey at the appropriate level of the Set-Up procedure, see section 3.9.4.

Stationary Signals

The data for each 1/1 octave band is obtained by combining the data from three 1/3 octave bands covering the same frequency range. The 1/3 octave band data is synthesised as described in section 4.2.15. In the same way as described in section 4.2.15 there are two methods of producing 1/1 octave band data, the first is with the RECORD pushkey of the Analyzer set to "Stop" and the second is with it set to "Cont".

Transient Signals (2033 only)

The data for each 1/1 octave band is obtained by combining the data from three 1/3 octave bands covering the same frequency range. The 1/3 octave band data is synthesised as described in section 4.2.15.

1/3 and 2/3 Octave Bands

Fig. 4.28 shows a 1/1 octave band plot, this is called a spectrogram. It can be seen clearly that each octave band is made up of three 1/3 octave bands. There are however two exceptions in this case, these are shown at the beginning and at the end of the spectrogram. At the beginning there is a single 1/3 octave band and at the end there is a 2/3 octave band (whose centre frequency lies on the line dividing the the two bands). The reason for this is that the preferred centre frequencies do not allow an integer number of 1/1 octave bands to fit the chosen overall frequency range.

When a 1/1 octave band spectrum is displayed on the screen of the Analyzer the cursor may be used to read off the correct decibel levels.

4.2.18 Integration [/jω] [9] – Sub-Function No: 29

This is a sub-function which enables a given spectrum to have its spectral components divided by their angular frequencies ω. The result is a spectrum whose time domain function represents the integration with respect to time of the time domain function of the original spectrum. An example of a useful application is where an acceleration spectrum can be converted to a velocity spectrum and further still to a displacement spectrum. The location of the result will depend on which main function the ***Integration*** sub-function is used with. The main functions that can be used with the ***Integration*** sub-function are **List, Plot, Move to 2031/2033** and **Move to Temp. Mem.** Pushkey sequences of each example are given in the sections dealing with the aforementioned main functions. Sources (storage media) for the main functions can be **2031/2033, Temp. Memory, Volatile Memory, Cont. Memory** or **7400.**

The data types intended for use with the ***Integration*** sub-function are as follows:

Spectrum	400 line (Baseband) High Resolution (2033 only) Ref. Spectrum (stored in Analyzer Memory) Spectrum Difference (2313 Function) Spectrum Ratio (I/M 2033, I–M 2031)
Differentiation	Single and Double
Integration	Single

Operating Set-Up Parameters

The operating Set–Up parameters for the **Integration** sub-function are shown below and are for the default case.

FUNCTION	PARAMETER		VALUE	UNIT
29 Integration	1 Pivot point	:	10.0000E+04	Hz

1- Pivot point: Accepts values from 0.000 25 to 20 000. These are printed and may be entered in exponential form e.g. 10 000 is printed as `10.0000E+4`. The UNITS can be either in Hz, as is for the default case shown above, or as spectral LINE NO. which can be chosen by pressing the **Yes** pushkey at the appropriate level of the Set-Up procedure, see section 3.9.4.

The pivot point represents the point in the spectrum about which the remainder of the spectrum appears to rotate clockwise as a result of integration, i.e. it will be located in the centre of the displayed dynamic range. This gives the user the opportunity of selecting which part of the spectrum after integration will be situated in the centre of the plot.

The ***Integration*** sub-function can be used twice on the same spectrum, further integration attempts will be blocked by the 2313. A spectrum that has been differentiated twice, see section 4.2.19, can be integrated a maximum of four times.

4.2.19 Differentiation[*jω] [–] – Sub-Function No: 30

This is a sub-function which enables a given spectrum to have its spectral components multiplied by their angular frequencies ω. The result is a spectrum whose time domain function represents the differentiation with respect to time of the time domain function of the original spectrum. An example of a useful application is where a displacement spectrum can be converted to a velocity spectrum and further still to an acceleration spectrum. The location of the result will depend on which main function the ***Differentiation*** sub-function is used with. The main functions that can be used with the ***Differentiation*** sub-function are **List, Plot, Move to 2031/2033** and **Move to Temp. Mem.** Pushkey sequences of each example are given in the sections dealing with the aforementioned main functions. Sources (storage media) for the main functions can be **2031/2033, Temp. Memory, Volatile Memory, Cont. Memory** or **7400.**

The data types intended for use with the ***Differentiation*** sub-function are as follows:

Spectrum	400 line (Baseband) High Resolution (2033 only) Ref. Spectrum (stored in Analyzer Memory) Spectrum Difference (2313 Function) Spectrum Ratio (I/M 2033, I–M 2031)
Differentiation	Single
Integration	Single and Double

Operating Set-Up Parameters

The operating Set–Up parameters for the **Differentiation** sub-function are shown below and are for the default case.

FUNCTION	PARAMETER		VALUE	UNIT
30 Differentiation	1 Pivot point	:	10.0000E+04	Hz

1-Pivot point: Accepts values from 0.000 25 to 20 000. These are printed and may be entered in exponential form e.g. 10 000 is printed as `10.0000E+4` . The UNITS can be either in Hz, as is for the default case shown above, or as spectral LINE NO. which can be chosen by pressing the **Yes** pushkey at the appropriate level of the Set-Up procedure, see section 3.9.4.

The pivot point represents the point in the spectrum about which the remainder of the spectrum appears to rotate anti-clockwise as a result of differentiation, i.e. it will be located in the centre of the displayed dynamic range. This gives the user the opportunity of selecting which part of the spectrum after differentiation will be situated in the centre of the plot.

The **Differentiation** sub-function can be used twice on the same spectrum, further differentiation attempts will be blocked by the 2313. A spectrum that has been integrated twice, see section 4.2.18, can be differentiated a maximum of four times.

4.2.20. Personal Text [/] [100] – Function No: 110

This function enables up to 20 characters of text to be entered or edited via the front panel into one or more of the text lines. There are 5 text lines which, if activated in the current Set-up, appear in the Plot or List read-outs. The inserted text is stored in the continuous memory.

Operating Set-Up Parameters

The operating Set-Ups available with the **Personal Text** function are shown below and are for the default case. Note that the Set-ups are used for enabling or disabling the text. Entering personal text is covered later.

FUNCTION	PARAMETER		VALUE	UNIT
0 List	1 Personal text	: NO		
1 Plot	1 Personal text	: NO		
(/100) 110 Personal text	1 Enable line 0	: NO		
(/100) 110 Personal text	2 Enable line 1	: NO		
(/100) 110 Personal text	3 Enable line 2	: NO		
(/100) 110 Personal text	4 Enable line 3	: NO		
(/100) 110 Personal text	5 Enable line 4	: NO		

The **List** and **Plot** functions both have a **1 Personal Text** parameter which can be enabled or disabled by pressing the **Yes** or **No** pushkey respectively when entering the VALUE in the Set-Up procedure. See section 3.9. If **Yes** is selected, then the **110 Personal Text** function is enabled for the relevant **List** or **Plot** function.

By selecting **110 Personal Text**, the individual text lines can be enabled or disabled by pressing the **Yes** or **No** pushkey respectively when entering the VALUE in the Set-Up procedure. Note that even if enabled, these text lines will only appear on the **List** or **Plot** read-out if enabled in the relevant **1 Personal text** parameter.

Entering Personal Text

Text can be entered and edited in the 5 text lines from 3 sources; over the IEC/IEEE interface (covered in section 6.6.13), over the Serial Interface (covered in section 7.1.2), or via the 2313 front panel.

Text is entered via the front panel by first selecting either number or character mode.

Character Mode

In character mode, the decimal equivalent of the ISO character is entered, separated by a '/'. The characters available with their decimal equivalents are given in Table 4.1. Note that numbers can also be entered in the character mode by entering their decimal equivalent.

The pushkey commands for accessing character mode are as follows:

Selects Personal Text character mode in text line 0

Selects Personal Text character mode in text line 0

Selects Personal Text character mode in text line Y where $0 \leq Y \leq 4$

No.	Char.	No.	Char.	No.	Char.	No.	Char.	No.	Char.	No.	Char.	No.	Char.	No.	Char.
0	Δ	16	π	32	SP	48	0	64	@	80	P	96	`	112	p
1	α	17	∫	33	!	49	1	65	A	81	Q	97	a	113	q
2	²	18	æ	34	"	50	2	66	B	82	R	98	b	114	r
3	Σ	19	σ	35	#	51	3	67	C	83	S	99	c	115	s
4	δ	20	τ	36	$	52	4	68	D	84	T	100	d	116	t
5	ε	21	ü	37	%	53	5	69	E	85	U	101	e	117	u
6	φ	22	√	38	&	54	6	70	F	86	V	102	f	118	v
7	ω	23	–	39	'	55	7	71	G	87	W	103	g	119	w
8	Ω	24	↑	40	(	56	8	72	H	88	X	104	h	120	x
9	⁰	25	↓	41	)	57	9	73	I	89	Y	105	i	121	y
10	₀	26	→	42	*	58	:	74	J	90	Z	106	j	122	z
11	Ø	27	←	43	+	59	;	75	K	91	[	107	k	123	{
12	λ	28	¯	44	,	60	<	76	L	92	\	108	l	124	|
13	μ	29	_	45	–	61	=	77	M	93	]	109	m	125	}
14	±	30	|	46	.	62	>	78	N	94	^	110	n	126	¯
15	■	31	|	47	/	63	?	79	O	95	_	111	o	127	DEL

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Table 4.1. List of personal text characters available with numbers used when writing the characters in character mode

Once character mode has been selected using one of the above pushkey sequences, the text in the selected text line can be inserted or edited by using the key commands listed in Table 4.2.

Pushkey Label	Effect
Help	Print selected text line
Exec./Ent.	Stop
/	Move to next character position
Clear Entry	Clear selected text line and return to first character position
0 to 127	Write (or overwrite) character according to Table 4.1
–	Delete character and move to next character position
.	Return to first character position
E	Move to previous character position

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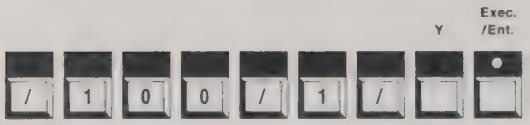
Table 4.2. Commands when operating in personal text character mode

Number Mode

In number mode, the numbers **0** to **9**, **E** and **.** as printed on the pushkeys, are entered directly. The pushkey commands for accessing number mode are as follows:

Selects Personal Text number mode in text line 0



Selects Personal Text number mode in text line Y where 0≤Y≤4

Once the number mode has been selected using one of the above pushkey sequences, the text in the selected text line can be inserted or edited by using the key commands listed in Table 4.3.

Pushkey Label	Effect
Help	Print selected text line
Exec./Ent.	Stop
/	Move to next character position
Clear Entry	Clear selected text line and return to first character position
0 to 9, –, . , E	Write (or overwrite) with number

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Table 4.3. Commands when operating in personal text number mode

Three different formats of read-outs are shown in Fig. 4.29 to 4.31 giving the locations of the five textlines by enabling all the textlines via the Set-Up. Fig. 4.29 gives a read-out using the **List** function. Fig. 4.30 and 4.31 give read-outs of a spectrum and a time function respectively using the **Plot** function. Note that the space for the "Comments" varies according to the number of personal text lines enabled.

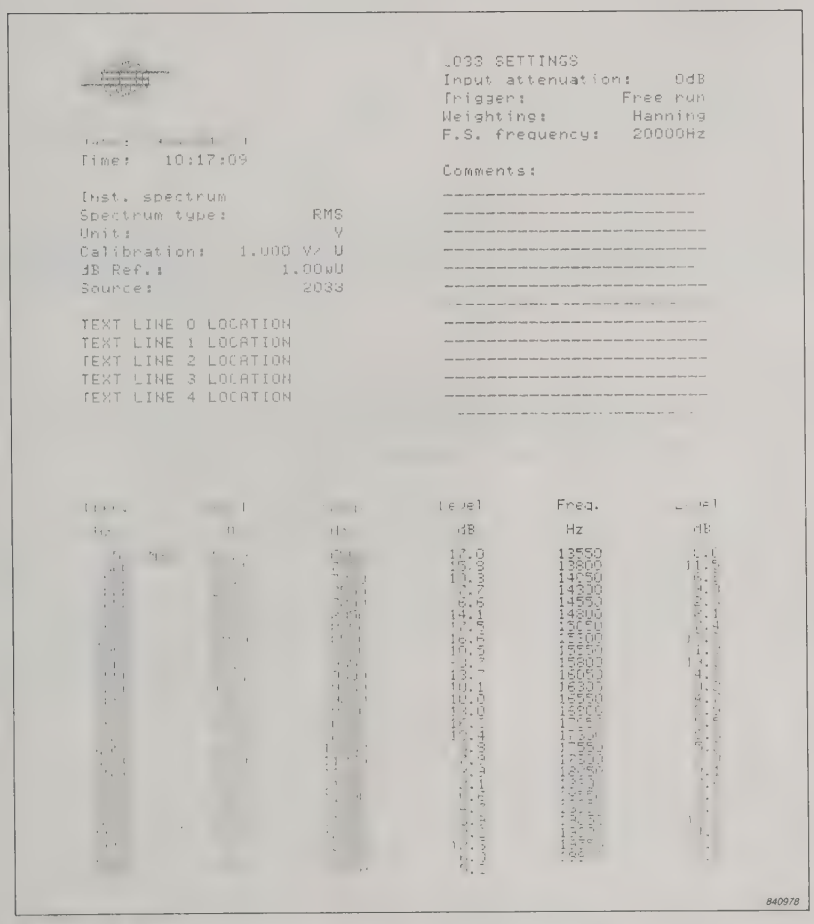


*Fig. 4.29. Sample read-out using the **List** function to show the location of the five personal text lines*

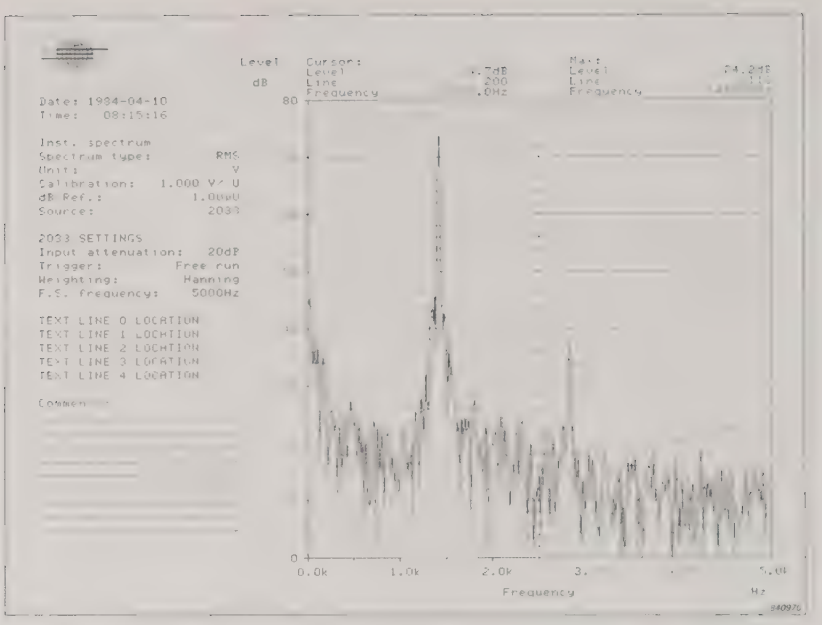


*Fig. 4.30. Sample read-out of a spectrum using the **Plot** function to show the location of the five personal text lines*

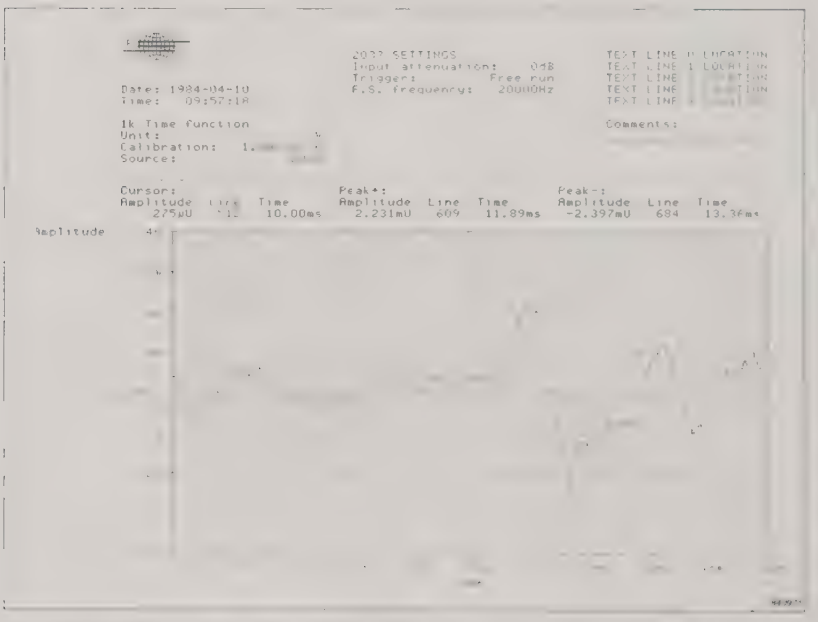


*Fig. 4.31. Sample read-out of a time function using the **Plot** function to show the location of the five personal text lines*

4.2.21. Execute 7400 Program [/] [101] – Function No: 111

This function loads a B&K "soft-function" program into the 2313 from the 7400 Digital Cassette Recorder then executes the program like a normal function. Soft-functions permit new documentation and measurement functions to be added to suit more specialised applications, and will be available at a later date from the B&K Software Department. Please contact your local B&K representative for details.

Pushkey Commands

The pushkey command for loading and/or executing a 7400 program is as follows:

The program in 7400 file X is loaded and run

where X is the tape file number allocated by the 7400, and Y and Z are the parameter values indicated in the literature accompanying the soft-function. Where no parameters are indicated, Y and Z can be ignored.

When loaded the soft-function is stored in a special volatile memory file and then executed. Only one soft-function may be stored at a time and it is retained up until time the 2313 is switched off or when another function is executed which requires the use of this file. If required, the stored function can be executed a second or third time, simply by repeating the above command. Any attempt to load and execute a 7400 file not containing a soft-function will return the 2313 to standby, plus print an `Error in code-function` message.

4.2.22. Store 7400 Program [/] [102] – Function No: 112

This function enables a work copy to be made on the users own tape, of a soft-function program which has been previously loaded in the 2313 using the **Execute 7400 Program** function (see section 4.2.21).

Pushkey Commands

The pushkey command for storing a program on 7400 tape is as follows:

Copies soft-function in 7400 file X from the 2313

4.2.23. Execute Sequence [/] [103] – Function No: 113

This function executes a key push sequence, previously entered and stored in the continuous memory using the **Enter Sequence** function in section 4.2.24. If the sequence contains one or more illegal or non existent functions and parameters, it will be terminated and an appropriate error message printed. It is not possible to activate the sequence via the IEC Interface of the 2313 or store it using an external medium such as

the 7400. Other relevant functions are **Wait**, **Wait Clock**, **Shift function**, **Write 2033 (2031) Pushkey**, **Relay On**, **Relay Off** and **Record Single**. An example of a key push sequence containing these functions can be found in the **Enter Sequence** section 4.2.24.

Pushkey Commands

The pushkey commands for executing a key push sequence are as follows:

This executes once, the key push sequence saved in the 2313

This executes X times, the stored key push sequence, where $0 \leq X \leq 29999$

4.2.24. Enter Sequence [/] [104] – Function No: 114

This function enables the user to enter a key push sequence containing up to 200 key pushes. All key pushes are saved in the continuous memory except **Reset** which ends entry of the sequence. The sequence can be edited using the **Edit Sequence** function section 4.2.25. It is not possible to save the sequence on tape or to remotely read in a sequence via the interface bus.

Pushkey Command

The pushkey command for entering a key push sequence is as follows:

The following key pushes are saved by the 2313 until **Reset** is pressed

Examples of Use

The following example gives a sequence for automatically recording spectra onto successive memory files. This starts with the command to enter the key push sequence. This is followed by the **Wait Clock** function which delays the execution of the sequence until the preset time is reached. The **Wait** function is then used to introduce a delay, which sets the repetition rate of the sequence if the sequence is executed more than once. The **Relay On** function is used, e.g., to switch on a sound source. The **Record Single** function is used to capture a full time function in the Analyzer. The **Relay Off** function then switches off the sound source. The **Write 2033 (2031) Pushkey** is used to activate the AVERAGING "Start" pushkey on the Analyzer which could start a scan average if used with a 2033. The **Wait** function is used again to ensure that the averaging is finished. The **Shift Function** is then used to activate the later defined function. Entry of the sequence is then terminated with the **Reset** key.

Before executing the sequence, the **Shift Function** has to be defined, which, in this case, is storing the input function displayed on the Analyzer into memory file 0. Note that when defining the **Shift Function**, the function will be executed, hence a dummy file will actually be stored in memory file 0.

Finally, **Execute Sequence** is used to execute the stored key push sequence, in this case ten times.

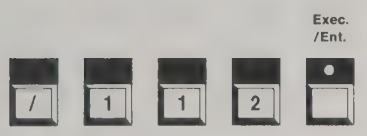
1. Entry of pushkey sequence

This starts the key push sequence

The **Wait Clock** function (section 4.2.28), where the 2313 waits until 9:55 (in this case) before continuing with the sequence.

The **Wait** function (section 4.2.27), where the 2313 waits for up to 10 mins (in this case), before continuing with the sequence.

The **Relay On** function (section 4.2.30), to activate the relay for switching on a B&K sound source.



The **Record Single** function (section 4.2.32), which activates the Analyzer **Record Single** pushkey to record a complete time function.

The **Relay Off** function (section 4.2.31), to deactivate the relay for switching off a B&K sound source.

The **Write 2033 (2031) Pushkey** function (section 4.2.29), used to activate the Analyzer AVERAGING "Start" pushkey.

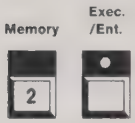
The **Wait** function again to ensure the Analyzer has finished processing before continuing with the sequence.

The **Shift Function** (section 4.2.26), to activate and increment the parameters of a function, defined prior to executing the key push sequence.

Ends and stores the key push sequence.

2. Defining the **Shift Function**

Initiates the **Shift Function** for retrieving and incrementing the following function.



Stores the input function displayed on the Analyzer, into Memory file 0.

3. Execution of stored key push sequence

The **Execute Sequence** program (section 4.2.23), used to execute the stored key push sequence ten times.

4.2.25. Edit Sequence [/] [105] – Function No: 115

This function enables editing of a key push sequence, whereby individual key pushes can be changed, inserted or deleted. The sequence is entered and stored in the continuous memory using the **Enter Sequence** function in section 4.2.24.

Pushkey Command

The pushkey command for editing a key push sequence is as follows:

The stored key pushes can be edited according to Table 4.4 until **Exec./Ent.** is pressed to terminate edit mode

Pushkey Label	Effect
Help	List sequence
〈0 to max.〉 〈Exec./Ent.〉	Select keypush line number
/ 〈Keypush〉	Insert 〈Keypush〉 in selected line number
–	Delete keypush
.	Select next keypush line
E	Select previous keypush line
Exec./Ent.	Stop

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Table 4.4. Commands when operating in Edit Sequence mode

Example of Use

If we take the key push sequence example given in **Enter Sequence** section 4.2.24, and want to change the **Wait Clock** time from 9:55:00 to 9:50:00. The procedure would be to select the appropriate line, delete the contents, then insert the new line at that point. The editing sequence is as follows:

This selects the **Edit Sequence** mode followed by a print-out of relevant commands as in Table 4.4

This selects item eight in the key push sequence. A print-out would result of the item i.e. 9 5 in this case.

This deletes the selected line and gives a print-out of the line with its new contents i.e. 9 EXECUTE in this case.

This inserts a 0 into line 9 and gives a print-out of the line, i.e. 9 0 in this case.

This ends the **Edit Sequence** mode.

4.2.26. Shift Function [/] [106] – Function No: 116

As mentioned already in the relevant sections, the **Exec./Ent** key may be used to repeat execution of certain functions plus automatically update their parameters. For carrying out the same operation with a stored key push sequence, however, a separate function termed **Shift** must be employed. This is intended for direct inclusion in a key push sequence stored with the **Enter Sequence** function and serves to fetch a function plus increment its parameter each time the sequence is executed.

Besides allowing information to be stored in or recalled from successive memory or tape files, the **Shift** function enables a stored key push sequence to be used for a number of separate tasks simply by entering a new function prior to executing the sequence. It is, however, only possible to fetch a single function at a time, whose parameter is to be incremented.

Pushkey Command

The pushkey command for executing the **Shift Function** is as follows:

This retrieves the function and increments its parameter

Example of Use

The usefulness of this function can be clarified by the following example which shows the procedure for reading out spectra to the Analyzer in sequence automatically. The spectra can be recorded with a long time interval between recordings and played back in seconds from which trends can be observed. The 2033 Analyzer is mentioned, although this can be replaced by 2031 which is equally valid. The spectra are stored and retrieved from memory files as there is faster access than with the 7400 files. Spectra are normally stored with the pushkey settings, so, in order to speed up accessing the spectra, it is recommended to only move the spectra by changing the **Move stored settings** in the current setup to **NO** (section 4.2.6), such that the relevant line of the setup for the Analyzer is as follows:

```
        FUNCTION                PARAMETER                        VALUE        UNIT
      5 2033              1 Move stored settings      : NO
```

The spectra are first recorded into the memory, then played back to the Analyzer, using the following key push sequence:

1. Storage of spectra into memory.

This stores the spectra into V. memory files 0 to 10

2. Entry and storage of key push sequence for retrieving and incrementing the function initiated in item 3 below.

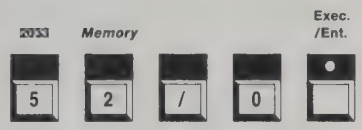
This starts the **Enter Sequence** program

This enters into the key push sequence, the command to retrieve and execute the defined function, then increment its parameter

This terminates and stores the key push sequence

3. Defining the **Shift Function**.

This initiates the **Shift** function to retreive and increment the parameters of the following function



This moves a spectrum from the volatile memory file 0 to the Analyzer screen and defines this as the shift function

4. Execution of stored key push sequence.

This executes the key push sequence 10 times, displaying the contents of memory files 1 to 10 on the Analyzer screen

A further example of the use of the **Shift Function** can be found in the key push sequence example in **Enter Sequence** section 4.2.24.

4.2.27. Wait [/] [107] – Function No: 117

When a time is entered and this function executed as part of a 200-step key push sequence (see section 4.2.24), the 2313 waits until the actual clock time is an exact multiple of the inserted time in seconds before continuing with the sequence.

Example 1: If 1 hour is inserted as the wait time and the clock is at 8:45:15 the 2313 will wait until 9:00:00 (i.e. 1 hour × 9) before executing the sequence. If the sequence is repeated it will be re-executed at 10:00:00 (i.e. 1 h × 10), 11:00:00 (i.e. 1 h × 11), etc.

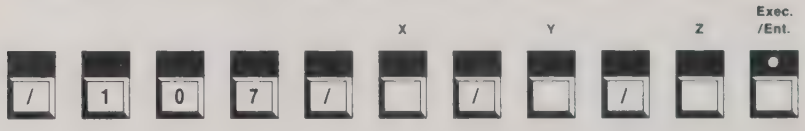
Example 2: If 18 minutes is inserted as the wait time and the clock is at 00:59:10 the 2313 will wait until 01:12:00 (i.e. 18 minutes × 4) before executing the sequence. If the sequence is repeated it will be re-executed at 01:30:00 (i.e. 18 min. × 5), 01:48:00 (i.e. 18 min. × 6), etc.

Example 3: If 1 minute 40 seconds (i.e. 100 s) is inserted as the wait time and the clock is at 10:40:20 the 2313 will wait until 10:41:40 (i.e. 100 s × 3845) before executing the sequence. If the sequence is repeated it will be re-executed at 10:43:20 (i.e. 100 s × 3846), 10:45:00 (i.e. 100 s × 3847), etc.

This function could be part of a key push sequence, entered using **Enter Sequence** section 4.2.24, or edited using **Edit Sequence**, section 4.2.25, to allow time for a function to be completed before continuing to the next step, or to ensure functions are initiated at regular time intervals independent of the time it takes to execute the function.

Pushkey Command

The pushkey command for inserting the wait time is as follows:



The chosen time will be entered where: X is the number of hours, where 0≤X≤23. Y is the number of minutes, where 0≤Y≤59. Z is the number of seconds, where 0≤Z≤59.

An example, illustrating the use of the **Wait** function, is given in section 4.2.24.

4.2.28. Wait Clock [/] [108] – Function No: 118

When a time is entered and this function executed as part of a key push sequence, the 2313 waits until the entered time corresponds with the 2313 clock time before continuing with the sequence. A further feature is that if this function is repeated with the same time as previously used, this function is ignored. This enables a sequence to be performed a number of times where the 2313 only waits for the clock the first time. The key push sequence can be entered using **Enter Sequence**, section 4.2.24, or edited using **Edit Sequence**, section 4.2.25.

Pushkey Command

The pushkey command for inserting the wait clock time is as follows:

The chosen time will be entered where: X is the number of hours, where 0≤X≤23. Y is the number of minutes, where 0≤Y≤59. Z is the number of seconds, where 0≤Z≤59.

An example, illustrating the use of the **Wait Clock** function, is given in section 4.2.24.

4.2.29. Write 2033 (2031) Pushkey [/] [109] – Function No: 119

This function produces a key push on the Analyzer. This can be useful where the settings of the Analyzer are to be changed during execution of a key push sequence. The key push sequence can be entered using **Enter Sequence**, section 4.2.24, or edited using **Edit Sequence**, section 4.2.25.

Pushkey Command

The pushkey commands for activating an Analyzer pushkey are as follows:

The relevant Analyzer key will be activated where: X is the decimal equivalent of the ASCII pushkey code, where $64 \leqslant X \leqslant 92$. Y is the setting code, a number typed directly, where $0 \leqslant Y \leqslant 10045$.

The relevant Analyzer key will be activated where: X and Y are as above. Z is the amount added to Y the next time **Exec./Ent.** is activated alone.

The parameter X is the decimal equivalent of the ASCII Pushkey Code. The pushkey code is found in the Analyzer instruction manual and decimal equivalent can be found from Table 4.1 in section 4.2.20. The parameter Y is the Setting Code, also found in the Analyzer instruction manual, but as a number which is typed in directly. Parameter Z is a number by which parameter Y is increased each time **Exec./Ent.** alone is pressed to repeat the function. This permits, e.g., stepping through samples by simply activating **Exec./Ent.**, when a time function is displayed.

An example of the use of this function can be found in the key push sequence example in **Enter Sequence** section 4.2.24.

4.2.30. Relay On [/] [110] – Function No: 120

This function permits remote switching of external equipment via the remote control socket on the rear panel of the 2313. This could be used, e.g., to switch on a noise source when executing a key push sequence. The key push sequence can be entered using **Enter Sequence**, section 4.2.24, where an example of use in a key push sequence can be found.

Pushkey Command

The pushkey command for relay on is as follows:

This will open the relay contacts and switch on a B&K Noise Source

Relay On is factory preset to open circuit pins 4 and 5 of the Remote Control socket (see Fig. 2.5). This is directly suited for switching on and off the B&K Sound Power Source Type 4205 and Noise Source Type 4224. For connection to the **Remote Control** socket, a standard 8 pin DIN Cable AQ 0034 may be used.

For use with other external equipment which requires a make connection for activation, **Relay On** (and **Relay Off**, section 4.2.31), can be modified accordingly. This is done by carefully easing off the **Remote Control** socket lead from the interface board pin J8 shown in Fig. 4.32 and fitting it to pin J9 indicated. The interface board is mounted on the rear panel and is accessible on sliding off the top panel which is fastened by two screws on the back of the instrument. Before attempting to release the top panel ensure that the 2313 is disconnected from the mains supply.

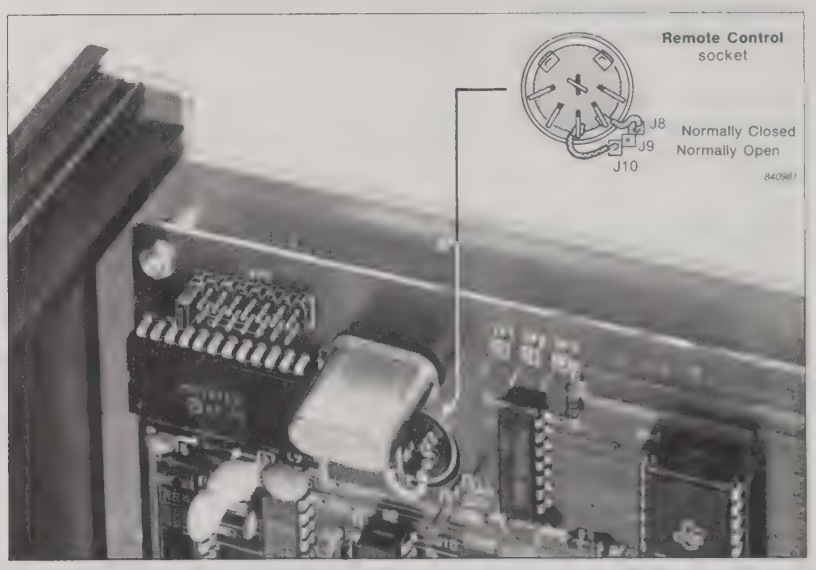


*Fig 4.32. **Relay On** and **Relay Off** connections on the digital interface board of the 2313*

4.2.31. Relay Off [/] [111] – Function No: 121

When used with **Relay On**, section 4.2.30, this function permits remote switching of external equipment via the remote control socket on the rear panel of the 2313. When **Relay Off** is activated, pins 2 and 5 of the remote control socket on the rear panel are connected, if previously disconnected using **Relay On**. This could be used, e.g., to switch off a noise source when executing a key push sequence. For use with other equipment which require a make connection for activation and break connection for deactivation, see the **Relay On** section. An example of use in a key push sequence can be found in **Enter Sequence** section 4.2.24.

Pushkey Command

The pushkey command for relay off is as follows:

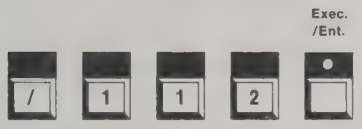
This will close the relay contacts and switch off a B&K Noise Source

4.2.32. Record Single [/] [112] – Function No: 122

This function activates the Analyzer **Record Single** key. After activating the Analyzer **Record Single** key, the Analyzer **Record Stop** key is continually sensed until it is activated, whereupon the 2313 continues operation. This ensures that a whole 10 K time record is captured by the Analyzer before continuing with further analyis. An example of use in a key push sequence can be found in **Enter Sequence** section 4.2.24.

Pushkey Command

The pushkey command for Record Single is as follows:



This will activate the Analyzer **Record Single** pushkey

4.2.33. Level – Function No: 200

Under the COMMON SET–UP there are four aspects of the signal level which can be user defined and are common to all Functions which deal with the signal level. These are shown below and are for the default case.

```
COMMON SETUP:
    FUNCTION              PARAMETER                      VALUE        UNIT
200 Level              1 Select unit:   U =        :                  V
200 Level              2 Calibration factor        :   1.0000E+00     V/ U
200 Level              3 dB reference              :   1.0000E-06     U
200 Level              4 Spectrum type             : RMS              U
```

1-Select unit: U=: This allows the user to select the correct units for the measurements. There are eleven possibilites to choose from and they can be set-up individually by pressing the **Yes** pushkey at the appropriate level of the Set-Up procedure, see section 3.9.4. The eleven possibilities are:

V	Voltage
Pa	Pascals
m/s²	Acceleration
m/s	Velocity
m	Displacement
N	Newtons
psi	Pounds per square inch
g	Gravitational acceleration
in./s	Inches per second
mil	Thousandths of an inch
lbf	Pounds force

The chosen unit for **U** will appear on all plotted and listed outputs.

2-Calibration factor: This accepts values from 10^{-12} to 10^{12} which can be keyed in in exponential form. It is used to state the relationship between the input voltage, **V**, to the Analyzer and the corresponding magnitude of the chosen unit **U**. It is given as a ratio **V/U** i.e. volts per unit. The following examples will help to clarify this. For a microphone having a sensitivity of 47,3 mV per Pa, where Pa is understood to be the **Selected unit**, the **Calibration factor** will be keyed in as **47.3E–3**. For an accelerometer and its preamplifier having an overall sensitivity of 10 mV per m/s^2, where m/s^2 is understood to be the **Selected unit**, the **Calibration factor** will be keyed in as **10E–3**. Similarly, for a force transducer and its charge preamplifier having an overall sensitivy of 4 mV per N, where N is understood to be the **Selected unit**, the **Calibration factor** will be keyed in as **4E–3**.

3-dB reference: This accepts values from 10^{-12} to 10^{12}. It is used to fix the reference value for decibel levels. For acoustics the reference value is $20\,\mu$Pa, where Pa is understood to be the **Selected unit**, the **dB reference** will be keyed in as **20E–6**. For vibration acceleration the reference value is $1\,\mu\,m/s^2$, where m/s^2 is understood to be the **Selected unit**, the **dB reference** value will be **1E–6**. Similarly for force measurements the reference value is $1\,\mu$N, where N is understood to be the **Selected unit**, the dB reference will be keyed in as **1E–6**.

4-Spectrum type: This allows the user to select what type of spectrum is to be listed or plotted. The default case is RMS and by pressing the **Yes** pushkey at the appropriate level of the Set-Up procedure, see section 3.9.4., three other spectrum types can be selected. These are **PWR** (Power), **PSD** (Power Spectral Density) and **ESD** (Energy Spectral Density).

The PWR spectrum will be similar to the RMS spectrum because their definitions in decibel form are equal. The PSD spectrum incorporates the filter bandwidth in its definition. The filter bandwidth being $1{,}5\beta$ for the Hanning weighting and β for flat weighting, see under **Noise Bandwidth** in the specifications of the Analyzer. The ESD spectrum incorporates both filter bandwidth and the effective length of the time record in its definition. The effective time record will depend upon the Analyzer and its mode of operation. There is only one mode which is possible on the 2031, i.e. Baseband, whereas three modes are possible on the 2033, i.e. Baseband, Zoom and Scan Averaging. Table 4.5 and Table 4.6 summarise the relationship between Analyzer mode and the effective length of the time record which is given in terms of the sampling interval ΔT.

The definitions for the listed and plotted RMS, PWR, PSD and ESD levels are as follows:

$$L_{RMS} = L_{PWR} = 10\,Log_{10}\frac{U^2}{U_{ref}}$$

$$L_{PSD} = 10\,Log_{10}\frac{U^2}{B\,U_{ref}}$$

$$L_{ESD} = 10\,Log_{10}\frac{U^2\,T}{B\,U_{ref}}$$

where U = the root mean square of the selected unit

U_{ref} = the dB reference value

B = the bandwidth in Hz

T = the effective record length in seconds

Fig. 4.33 illustrates what other parameters exist in the background of the shown parameters. Most of them can be called up by the function under present discussion. The remainder, i.e. spectrum types, can be called up via the Analyzer setup or certain subfunctions

Mode	Effective Length of Time Record T	
	Hanning	Flat
Baseband	$^3/_8 . 1024 . \Delta T$	$1024 . \Delta T$
Zoom (2033 only)	$^3/_8 . 10240 . \Delta T$	$10240 . \Delta T$

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$\Delta T = 1/(2{,}56 . \text{Full Scale Frequency})$

Table 4.5 Relationship between effective length of time record used in ESD definition and the Analyzer modes Baseband and Zoom

Mode	Hanning Only	
	No. of Spectra	Effective length of time record T
Scan Averaging (2033 only)	37	$9^1/_4 . 1024 . \Delta T$
	73	$9^1/_8 . 1024 . \Delta T$
	145	$9^1/_{16} . 1024 . \Delta T$
	289	$9^1/_{32} . 1024 . \Delta T$
	577	$9^1/_{64} . 1024 . \Delta T$
	1153	$9^1/_{128} . 1024 . \Delta T$

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$\Delta T = 1/(2{,}56 . \text{Full Scale Frequency})$

Table 4.6 Relationship between effective length of time record used in ESD definition and the Scan Averaging mode

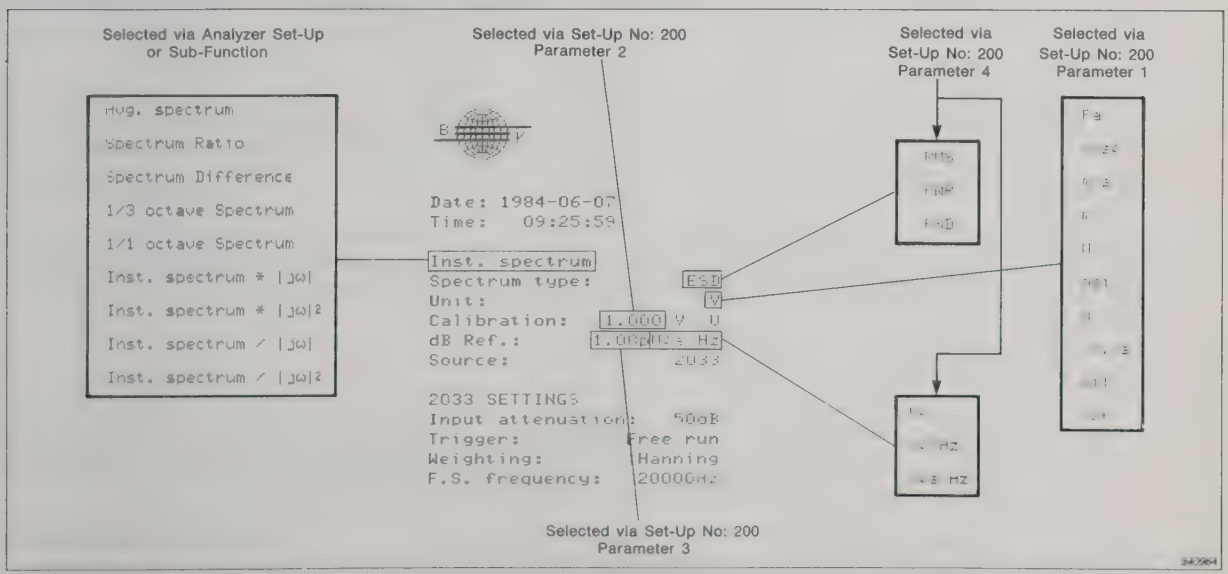

Fig. 4.33. Parameters and spectrum types which exist in the background of the shown parameters and spectrum type

4.2.34. Frequency – Function No: 201

Under the COMMON SET–UP there are five aspects of the signal frequency which can be user defined and are common to all functions which deal with the signal frequency. These are shown below and are for the default case

```
COMMON SETUP:
    FUNCTION              PARAMETER                    VALUE        UNIT
201 Frequency         1 Scale                    : Selected scale
201 Frequency         2 Selected harmonic        :       1
201 Frequency         3 Sel. harm. frequency     :  50.0000E+00     Hz
201 Frequency         4 Calculate THD            : NO
201 Frequency         5 Frequency unit           :                  Hz
```

1-Scale: This permits the user to choose between the **Selected scale** and the **Harmonic scale**, this is done by pressing the **Yes** pushkey at the appropriate level of the Set-Up, see section 3.9.4. If the **Selected scale** is chosen then the frequency will be scaled in either Hz or rpm (revolutions per minute), the choice being decided by what setting is keyed in under **5-Frequency unit**, see below. If the **Harmonic scale** is chosen then the frequency will be scaled in harmonic order numbers.

2-Selected harmonic: Accepts values from 1 to 4000. It allows the user to enter the order number of a selected harmonic. The user does this by observing the order number of a given harmonic displayed on the screen of the Analyzer and then keying this in as the **Selected harmonic** during the Set-Up procedure. The higher the order number the better will be the accuracy of the 2313 in determining the frequency of the first harmonic.

3-Sel. harmonic frequency: Accepts values from 0,00025 to 20000 which can be keyed in in exponential form i.e. **1E3** which represents 1000. The figure keyed in is the frequency of the selected harmonic mentioned above. This is done by moving the cursor of the Analyzer to the selected harmonic and reading off the relevant figure from the textline of the Analyzer. In the case of the 2033 greater accuracy can be obtained by zooming in on the Selected harmonic frequency. Alternatively the spectral Line Number pertaining to the selected harmonic can be keyed in. This should be done after selecting **Line Number** by pressing the **Yes** pushkey at the appropriate level of the Set-Up procedure, see section 3.9.4.

4-Calculate THD: Accepts **Yes** or **No** while in the Set-Up mode. THD stands for Total Harmonic Distortion. If the calculation is carried out then the result will appear as a percentage on the **List** and **Plot** charts.

5-Frequeny unit: Can be in either Hz or rpm (revolutions per minute). The choice is made by pressing the **Yes** pushkey at the appropriate level of the Set-Up procedure. Chosing rpm has the effect of multiplying the frequency scale by sixty.

4.2.35. Time – Function No: 202

Under the COMMON SET-UP there are two selectable zero points from which the time domain signal can be measured for listing and plotting purposes. As the name implies, each represents a time datum which is set to zero.

In the default case shown below the zero point is set at the start of record.

```
COMMON SETUP:
    FUNCTION              PARAMETER                    VALUE        UNIT
202 Time                  1 Zero point              : Start of record
```

Alternatively the zero point can be set to **Trigger point** by pressing the **Yes** pushkey at the appropiate level of the Set-Up procedure, see section 3.9.4.

Start of record: The record referred to here is the length of signal which is stored in digital form in the memory of the Analyzer prior to FFT processing, i.e. 1 K for the 2031 and 10 K for the 2033. The start of this record becomes the zero point of the time scales used for all listed and plotted outputs. With the 2031 the listed and plotted outputs will always begin with time equal to zero since they will always represent 1 K samples. With the 2033 there are two possible ways of listing and plotting the stored signal. The first utilises the entire 10 K samples of the stored signal in which case the listed and plotted time records will always begin with time equal to zero. The second utilises only 1 K samples which could be placed anywhere (by the cursor of the Analyzer) within the original 10 K. In the latter case the listed and plotted time records will begin with a particular time value depending on where in the original 10 K they happened to be located.

Trigger point: The trigger point becomes the zero point of the time scales used for plots and listings.

When COMMON SET-UP's are selected they are automatically executed in parallel with the documentation and storage functions of the apparatus.

4.3. BZ 7002/BZ 7003 ERROR CODES

ERROR NO: 0 Paper drive and printing are inhibited. Fit new paper roll to restore normal operation.

Note: If the paper drive remains inhibited, the alignment of the paper sensor should be checked. See the separate Service Manual for the 2313.

ERROR NO: 1 Attempt to alter Default Set-Up no. 0. Is possible with Operating Set-Ups no. 1, 2 and 3 only.

ERROR NO: 2 Attempt to enter clock data outside acceptable limits. Acceptable values are:

Year: 1900 to 9999
Month: 1 to 12
Day: 0 to 31
Hours: 0 to 23
Minutes: 0 to 59

ERROR NO: 3 Non existent Set-Up, i.e. Set-Up no. greater than 3

ERROR NO: 4 Non existent Function, i.e. Function no. greater than 122

ERROR NO: 5	Non existent Parameter, i.e Parameter no. greater than that available with particular function chosen. See Function and Parameter list.
ERROR NO: 6	Parameter value outside limits. The range of parameter values is indicated by the error message.
ERROR NO: 7	Error in character input.
ERROR NO: 8	No room for saving measurement in C. Memory. If the measurement is newly generated, it may be recalled from the Temporary Memory.
ERROR NO: 9	Attempt to save measurement exceeding maximum file number of C. Memory. If the measurement is newly generated, it may be recalled from the Temporary Memory.
ERROR NO: 10	Attempt to read V. or C. Memory file (or activate 200 step control sequence) that does not exist. For file listing, activate **Menu** plus either the **V. Memory** or **C. Memory** function.
ERROR NO: 11	No room for saving measurement in V. Memory. If the measurement is newly generated one, it may be recalled from the Temporary Memory.
ERROR NO: 12	Attempt to save measurement exceeding maximum file number of V. Memory. If the measurement is a newly generated one, it may be recalled from the Temporary Memory.
ERROR NO: 13	Function requiring a processing capability outside the range of the working memory. For example, recording a series of measurements where the maximum number of measurements which may be stored depends on whether or not they should be averaged.
ERROR NO: 14	Attempt to save measurement in a store–secured V. or C. Memory file already containing a measurement. If the measurement is a newly generated one, it may be recalled from the Temporary Memory.
ERROR NO: 15	Attempt to delete a V. or C. Memory file safeguarded by the Delete–Secured function.
ERROR NO: 16	Attempt to activate a function via the IEC interface without first assigning control of the interface to the 2313 or entering the appropriate parameter values for the function.
ERROR NO: 17	Error in IEC data.
ERROR NO: 18	Job specification error in data input to the IEC Interface of the 2313 i.e. non existent function or parameter formatting error.
ERROR NO: 19	IEC Time Out. No communication via the IEC interface or communication interrupted for a period lasting 5 seconds or more. Normally indicates minor fault with external equipment and/or connection with equipment not suited for use with BZ 7002 or BZ 7003. Check all interface cable connections, plus Power and Address Switch settings.
ERROR NO: 20	Attempt to read tape file not originating from the 2313.
ERROR NO: 21	Tape read error, caused by tape drop out, for example.

ERROR NO: 22	Attempt to read beyond last file present on tape. Normally occurs if non existent tape file named.
ERROR NO: 23	Attempt to save or read beyond end of tape.
ERROR NO: 24	Attempt to substitute tape file on 7400 without file substitution option being fitted.
ERROR NO: 25	No cassette inserted or lid of tape compartment not closed
ERROR NO: 26	Substitution of tape file with memory file of the 2313 not possible on account of different file sizes.
ERROR NO: 27	Attempt to overwrite or delete a write–protected Digital Tape Cassette.
ERROR NO: 28	Attempt to read incomplete tape file, the end of which has been damaged or accidently deleted during manual operation of the 7400.
ERROR NO: 29	Attempt to read a 7400 tape file not containing a soft function. To help locate the correct file, activate **Memory Menu** plus **7400**. See section 4.2.8.
ERROR NO: 30	Error in tape file number when reading spectra which have been recorded with the 7400 without a 2313 in the analysis set-up. During recording, the 7400 allocates the file number which, if not the same as that on which the tape is stationed during reading, will result in a error message.
ERROR NO: 31	File substitution is impossible due to the file substitution option fitted to the 7400.
ERROR NO: 32	Illegal function or combination of functions. Check relevant pushkey sequence.
ERROR NO: 33	Execution of stored pushkey sequence not possible i.e. sequence contains one or more illegal or non existent functions and parameters.
ERROR NO: 34	Not used with BZ 7002 or BZ 7003.
ERROR NO: 35	Parameter value outside accepted limits.
ERROR NO: 36	Execution of function not possible on account of incorrect series file interval. For file listing, activate **Memory Menu** plus either the **V. Memory** or **C. Memory** function.
ERROR NO: 37 to ERROR NO: 49	Not used with BZ 7002 or BZ 7003 package as applicable.
ERROR NO: 50	Analyzer settings not corresponding e.g. trying to plot the difference between a time function and a spectrum.
ERROR NO: 51	The source data as interpreted by the 2313 is illegal. Check Analyzer settings (Time/Frequency).
ERROR NO: 52	The selected range is outside the range of the Analyzer.

ERROR NO: 53	Differentiation/Integration is not allowed. A maximum of two integrations or differentiations can be performed on the same spectrum, none on time functions.
ERROR NO: 54	The tape file does not originate from the BZ 7002 or BZ 7003 package as applicable.
ERROR NO: 55	The sub-function as interpreted by the 2313 is illegal. Check relevant pushkey sequence.
ERROR NO: 56	Attempt to enter frequency or time when in external sampling. These should be specified as line numbers.
ERROR NO: 57	Calculation is impossible due to overload of the maths processor. In practice this situation very rarely occurs.

5. USE WITH SIGNAL ANALYZERS TYPES 2032 AND 2034

As with other Application Packages available for the 2313, BZ 7002 and BZ 7003 are capable of producing hard-copy graphic plots of measurements presented on the display screen of the Dual Channel Signal Analyzers Types 2032 and 2034. Each copy takes approximately 10 seconds to produce and is fully annotated so that there are no control settings to note.

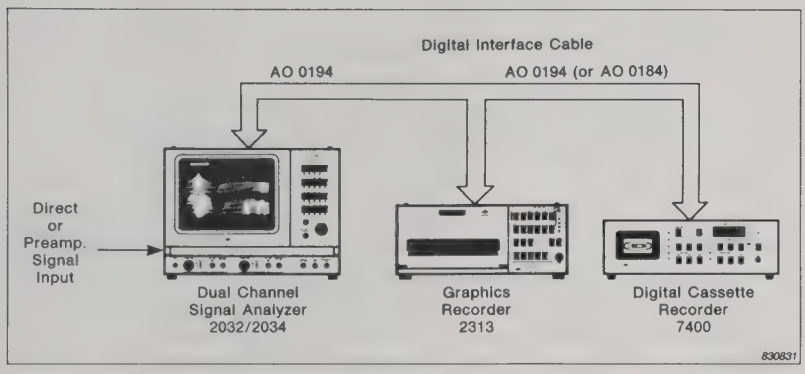

Fig. 5.1. Use of the 2313 Graphics Recorder with a 2032 or 2034 Dual Channel Signal Analyzer plus 7400 Digital Cassette Recorder

Interconnection and initial setting up of the recording and analysis equipment is similar to that described in section 4.1, except that "Interface Controller – Not Active" mode must be selected using the **Address Switch** of the 2313. This disables local front panel activation of the documentation, storage and measurement functions designed for 2031 and 2033 Analyzers, enabling the 2313 to serve as a conventional dot-matrix printer when its **Reset** plus **Exec./Ent.** keys are pressed. A hard copy of the measurement displayed on the 2032 or 2034 may then be obtained simply by pressing the **Digital I/O** "Plot" key of the Analyzer.

By including a 7400 Digital Cassette Recorder in the setup (see Fig.5.1), simultaneous recording and storage of measurements is possible. Alternatively, where it is required to confine readout to only one instrument at a time, then either the 2313 or 7400 may be deactivated by pressing their **Reset** or **Stop** key.

Note: Although 2032 and 2034 **Digital I/O** "Plot" files may be documented using the 2313, they cannot be re-displayed on the 2032 or 2034. For this purpose it is recommended that measurements are recorded using the **Digital I/O** "Output" key of the Analyzers to initiate read out to the 7400.

For further information on the use of the 2032 or 2034 Signal Analyzers, their Instruction Manuals should be consulted.

6. DATA TRANSFER OVER THE IEC INTERFACE

6.1. INTRODUCTION

The digital interface of the Type 2313 is designed according to the standard IEC 625-1 "Interface for Programmable Measuring Apparatus Byte-Serial Bit Parallel". Since the only significant difference between this and the IEEE Standard 488 – 1978/ANSI MC1.1 – 1975 is the type of connector used, compatibility with these standards is only a question of which connecting cable is used. Connection of the Type 2313 to an IEC 625-1 interface bus system is made from the IEC BUS connector on the rear panel of the Type 2313 using cable AO 0194. Connection to an IEEE/ANSI interface bus system is made from the same connector using cable AO 0194 and adaptor AO 0195. Connection to an earlier B & K instrument fitted with a female, slide-lock connector, is made using cable AO 0184. For further details of instrument interconnections, refer to the B & K publication "INTERFACING BRÜEL & KJÆR INSTRUMENTS".

It is important to note that although the Type 2313 interface is designed according to the IEC standard, absolute compatibility with IEC or IEEE/ANSI interfaces designed by other manufacturers cannot be unconditionally guaranteed, since differences can occur within the limits of the specifications. Any problems encountered, however, will be of a software rather than a hardware nature. Where compatibility is in doubt, contact our local representative for details.

6.2. IEC FUNCTIONS IMPLEMENTED

The interface of the Type 2313 implements the following functions, as specified by the IEC standard. The clauses referred to are the relevant sections of the IEC publication specifying the functions. The equivalent sections in the IEEE/ANSI standard are given in parentheses.

Clause 6, Source Handshake (SH) Interface Function, (Section 2,3)
SH 1 — complete capability
Clause 7, Acceptor Handshake (AH) Interface Function, (Section 2,4)
AH 1 — complete capability
Clause 8, Talker (T) Interface Function, (Section 2,5)
T5 — complete capability
Clause 9, Listener (L) Interface Function, (Section 2,6)
L3 — complete capability
Clause 10, Service Request (SR) Interface Function, (Section 2,7)
SR 1 — complete capability
Clause 11, Remote Local (RL) Interface Function, (Section 2,8)
RL 1 — complete capability
Clause 12, Parallel Poll (PP) Interface Function, (Section 2,9)
PP 1 — remote configuration
Clause 13, Device Clear Interface (DC) Function, (Section 2,10)
DC 1 — complete capability

Clause 15, Controller Interface (C) Function, (Section 2,12)

- C1 — system controller
- C2 — send interface clear (IFC) and take charge
- C3 — send remote enable (REN)
- C4 — respond to service request (SRQ)
- C5 — send interface messages, receive control, pass control, pass control to self, parallel poll, take control synchronously

All other functions no capability

For further details of the above functions, refer to the relevant sections of the IEC or IEEE/ANSI standards.

6.3. ADDRESSING THE TYPE 2313

Each device in an IEC interface bus system has at least one listener and/or talker address depending on its function. When an interface controller contacts a device over the IEC interface, it sends a device address, which will contain the appropriate talker or

ASCII Address Characters		ADDRESS SWITCH					Address Code	
Listen	Talk	A5	A4	A3	A2	A1	decimal	octal
SP	@	0	0	0	0	0	0	0
!	A	0	0	0	0	1	1	1
"	B	0	0	0	1	0	2	2
#	C	0	0	0	1	1	3	3
$	D	0	0	1	0	0	4	4
%	E	0	0	1	0	1	5	5
&	F	0	0	1	1	0	6	6
'	G	0	0	1	1	1	7	7
(	H	0	1	0	0	0	8	10
)	I	0	1	0	0	1	9	11
*	J	0	1	0	1	0	10	12
+	K	0	1	0	1	1	11	13
,	L	0	1	1	0	0	12	14
-	M	0	1	1	0	1	13	15
.	N	0	1	1	1	0	14	16
/	O	0	1	1	1	1	15	17
0	P	1	0	0	0	0	16	20
1	Q	1	0	0	0	1	17	21
2	R	1	0	0	1	0	18	22
3	S	1	0	0	1	1	19	23
4	T	1	0	1	0	0	20	24
5	U	1	0	1	0	1	21	25
6	V	1	0	1	1	0	22	26
7	W	1	0	1	1	1	23	27
8	X	1	1	0	0	0	24	30
9	Y	1	1	0	0	1	25	31
:	Z	1	1	0	1	0	26	32
;	[	1	1	0	1	1	27	33
<	\	1	1	1	0	0	28	34
=	]	1	1	1	0	1	29	35
-		1	1	1	1	0	30	36

Table 6.1. 2313 Address Switch settings (shaded area factory setting)

listener address. This address is in ISO 7-bit code (or equivalent ASCII), bit 8 being unused for addressing, therefore remaining at logic 0. Table 6.1 gives a list of possible ADDRESS SWITCH settings with the corresponding device address in the form of ASCII characters for the different address modes.

Note that in a system where the Type 2313 is a controller, it is not necessary to set the address of the 2313 in order to operate the system. It will, however, be necessary to set the addresses of the other instruments in the system to their factory setting, which can be found in the relevant instruments instruction manual or on the label attached to the Application Package.

6.3.1. Setting the Address Switches

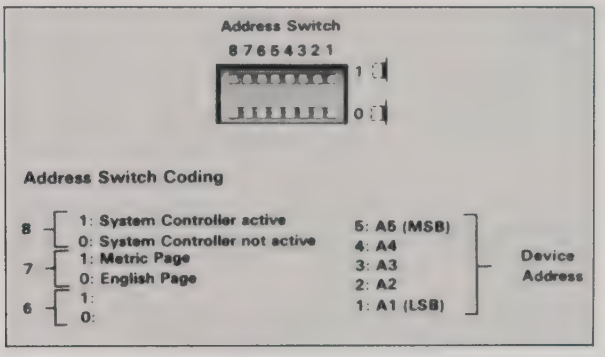

Fig. 6.1. Address Switch on the rear panel of the 2313

The listen and talk addresses over which the 2313 can be contacted via its IEC interface are selected by the **Address Switches** on the rear panel. For each switch pair, depressing the upper switch will give a logic 1 and depressing the lower switch will give a logic 0. The most significant bit (MSB) of the address is given by switch pair A5, while the least significant bit (LSB) is given by switch pair A1.

Switch pair 6 is unused, whilst switch pair 7 is for setting the page size to 'English' or 'Metric'.

Switch pair 8 is for activating or deactivating the 2313 as a system controller. When set at logic 0 ("System Controller not active"), the system controller function of the 2313 is deactivated, which enables the "Listen Only" mode to be activated manually (Section 6.4.1), or enables the 2313 to be operated remotely as described in Sections 6.4 to 6.12. This might imply that the 2313 works as an IEC controller but not as a system controller. However, the functions in the Application Package, as described in Section 1, may still be utilised. When set at logic 1 ("System Controller active"), the system controller function is activated and the 2313 can be used via its front panel pushbuttons to control itself and other instruments depending on the Application Package used (see Section 1). If the 2313 is to be used as a system controller then Sections 6.4 to 6.12 may be ignored.

On delivery, **Address Switch** numbers A1 to A5 on the rear panel of the Type 2313 are set to 00001, and switch pair 8 set to "System Controller active". Other address codes may be selected as required without influencing the operation of the 2313. In a 2313/BZ 7002/3 system with the Type 2031/2033 and Type 7400, it is not necessary to set the address switches A1 to A5 of the 2313.

Note that after activating any of the switches, it is necessary to press "Reset" or power off and then power on again.

6.4. MODES OF OPERATION

The following sections (6.4 to 6.12) require that **Address Switch** 8 is set to "System Controller not active".

6.4.1. Listen Only Mode

In this mode, the 2313 will print out any data on the interface bus. This mode is accessed manually by pressing **Reset** followed by **Exec./Ent.**

The **Listen**, **Entering** and **Exec./Ent.** LEDs will illuminate, indicating that the 2313 is in the "Listen Only" mode and ready to print data as described in Section 6.12.

Note: To return to the normal remote controllable mode, press Reset manually or clear the 2313 via the interface bus by sending ⟨DCL⟩, ⟨SDC⟩ or ⟨IFC⟩.

6.4.2. Remote/Local Operation

In addition to manual control, the 2313 can be controlled via the interface bus. Three control modes exists:

Local Mode: Some front panel controls can be used by the operator. Full manual control requires that switch 8 is set to "System Controller active" or the 2313 has received the MASTER Job (Section 6.6.3). Avoid using the Set-Up mode except for setting the clock.

Remote Mode: The 2313 can be controlled either remotely, or manually as in local mode.

Remote Mode with Local Lockout: Only remote control is possible, however, it is still possible to carry out a manual Reset.

6.5. THE INTERFACE JOB

Section 6.4.1 describes how to manually bring the 2313 in a mode ready for printing. For remote control over the interface bus, various Jobs can be specified, a list of which is given in Table 6.2.

A general diagram of the Job syntax is given in Fig. 6.2. The 'Job Header' describes the job to be carried out. This consists of one word which may be written in its entirety but may be shortened at least until the underlined part of the word.

Example: PRINTER ⟨LF⟩ or
PRINT ⟨LF⟩ or
PR ⟨LF⟩

will give the same result.

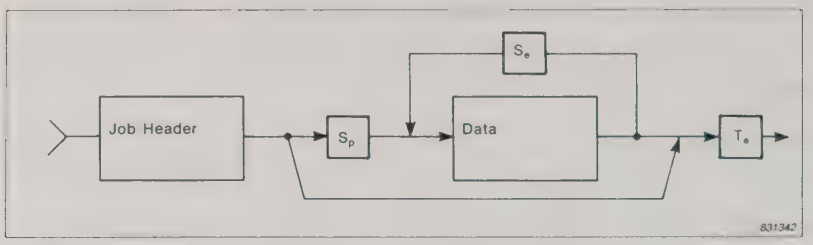

Fig. 6.2. Job syntax diagram

The 'Data', if present, is used to further specify the job. To separate the 'Job' from the Data, a separator S_p is used. Data may be formatted by a Separator S_e. The Job specification ends with a terminator T_e. The following separators and terminator are used:

S_p = ⟨Space⟩

S_e = ⟨ , ⟩

T_e = ⟨LF⟩ or ⟨EOI⟩ with any character.

The character to be sent is the character **between** the brackets – not the brackets themselves. Errors in the job specification will cause the 2313 to send an SRQ (Service Request) if the Service Request function is enabled by the Job specification SRQENABLE (see Section 6.6.11), otherwise an error message will be printed and the 2313 will lock up. After pressing 'Reset' to clear the lock up, the Service Request function will be disabled.

6.6. JOBS IN THE BZ 7002/3

This Section gives a descripton of each of the Jobs available in the BZ 7002/3 accompanied by a syntax diagram and an example of a program line. A list of interface Jobs is given in Table 6.2. Note that the word can be shortened up to the underlined part, e.g., 'DEFAULT' can be written as 'D', 'DE', 'DEF', etc.

Interface Job	Section	Interface Job	Section
DEFAULT	6.6.1.	SRQENABLE	6.6.11.
FUNCTION	6.6.2.	SRQDISABLE	6.6.11.
MASTER	6.6.3.	TEST	6.6.12.
NEWSETUP	6.6.4.	TEXT0	6.6.13.
PAGE	6.6.5.	TEXT1	6.6.13.
PRINTER	6.6.6.	TEXT2	6.6.13.
REPEAT	6.6.7.	TEXT3	6.6.13.
RETURNADR	6.6.8.	TEXT4	6.6.13.
SETUP	6.6.9.	TOPPAGE	6.6.14.
SHOWTIME	6.6 10.		

Table 6.2. List of interface Jobs in alphabetical order

6.6.1. DEFAULT

Sets the current Set-Up parameter values to default (from Set-Up 0).

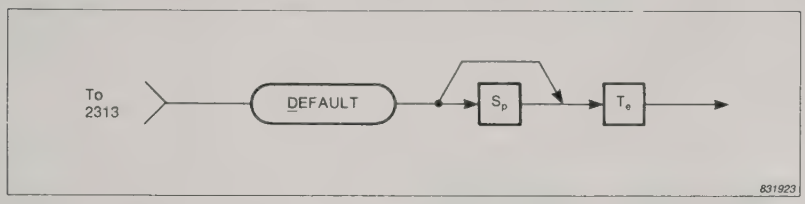

Fig. 6.3. Syntax diagram for changing the current Set-Up to default values

Example of Use

DEFAULT T_e

6.6.2. FUNCTION

In the preceding chapters, it is described how to use the 2313 functions such as **List**, **Plot** etc. The syntax diagrams in these chapters describe how to select functions and their associated parameters. The same functions and their parameters may be selected via the interface, using other separators between the function and parameter.

No.	Main Function Name	No.	Extended Function Name
0	List	11	Probability Density
1	Plot	12	Probability Distribution
2	Memory	111	Execute 7400 Program
3	Cont. Memory	112	Store 7400 Program
4	7400	119	Write 2033 (or 2031) Pushkey
5	2033 (or 2031)	120	Relay on
6	Delete	121	Relay off
7	Memory Menu	122	Record Single
8	Move to Temp. Memory	123	Set Unit Index*
9	Record Spectra		
10	Plot Av. Spectra		

T00437GB0

* see text

Table 6.3. List of BZ 7002/3 main and extended functions selectable over the interface using the given function number

No.	Sub-function Name
0	*Settings*
1 (21)	*Difference*
2	*Memory*
3	*C. Memory*
4	*7400*
5	*2033 (or 2031)*
6 (26)	*1/3 Octave*
7 (27)	*1/1 Octave*
8	*Temporary Memory*
9 (29)	*Integration*
10 (30)	*Differentiation*

T00438GB0

Table 6.4. List of BZ 7002/3 sub-functions selectable over the interface using the given sub-function number

Fig. 6.4 gives a general syntax diagram to activate one of the BZ 7002/3 functions listed in Table 6.3. The sub-functions are listed in Table 6.4, where the no. in brackets is used when accessing the sub-function in the Set-Up. Note, however, that sub-function numbers 6 and 7 cannot be accessed in the Set-Up for the BZ 7003 package. Detailed information on parameters can be found in the description of the actual function in the previous sections. As an example, a syntax diagram of the function 'Plot', is given in Fig. 6.5.

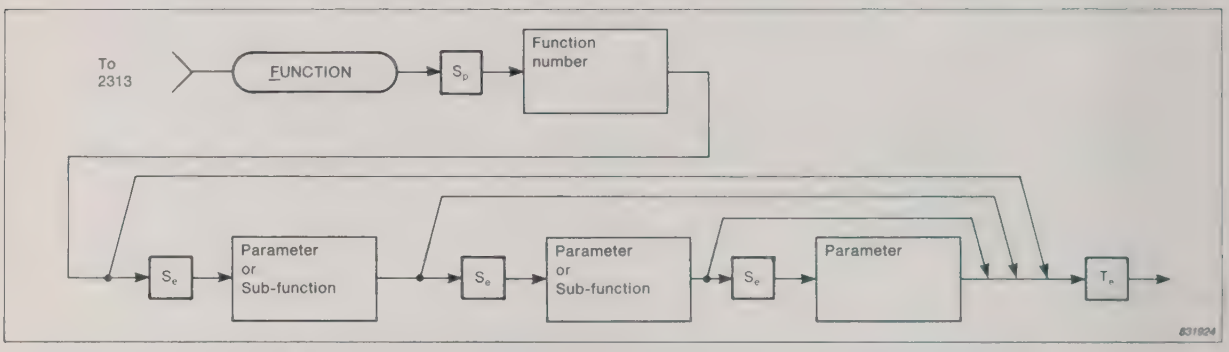

Fig. 6.4. General syntax diagram for activating one of the 2313 functions

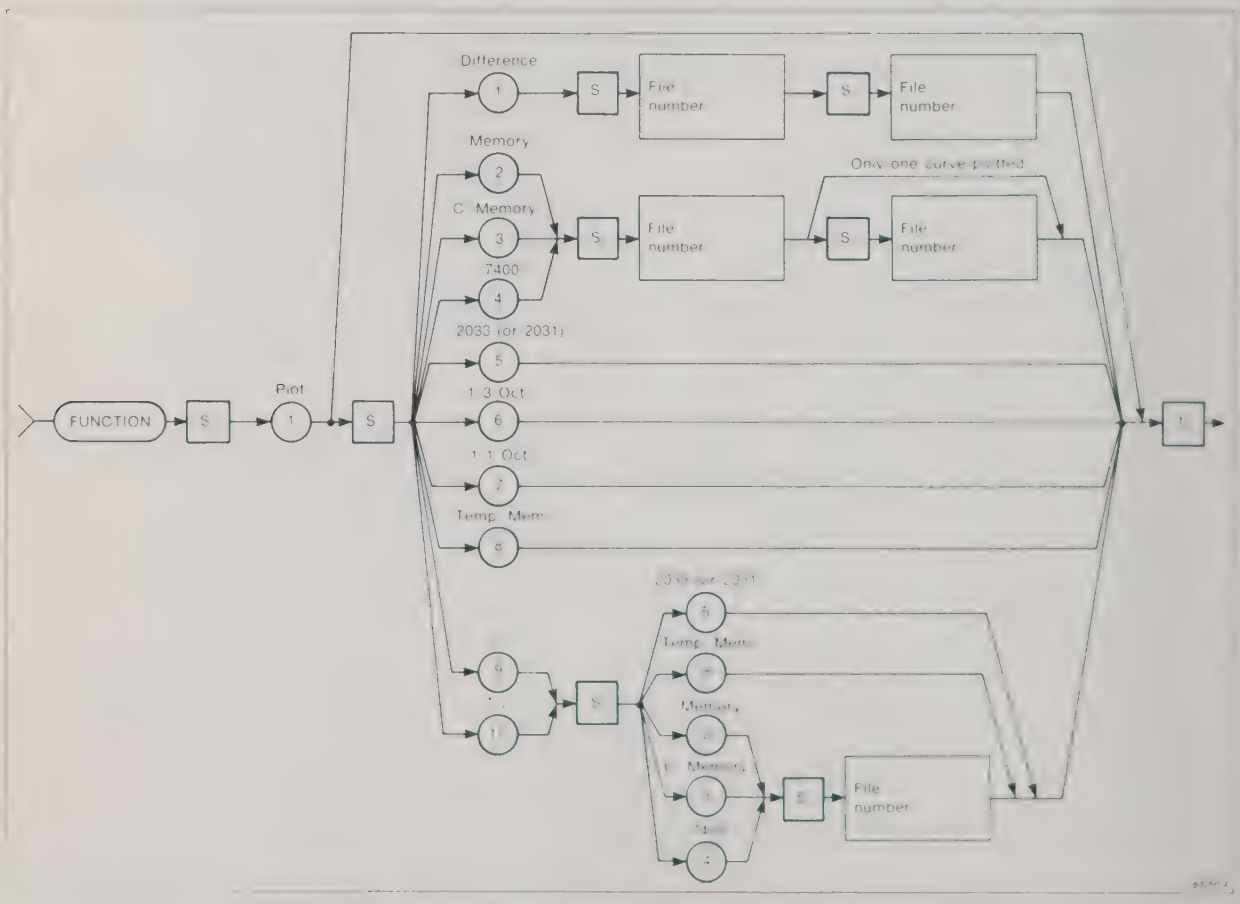

Fig. 6.5. Syntax diagram for activating the 'Plot' function

Examples of Use

RETURNADR R T_e
FUNCTION 1 , 1 , 3 , 8 T_e — Enables the 2313 to simultaneously plot two spectra stored in memory files 3 and 8

〈TCT〉 — The control character commands the 2313 to take control

FUNCTION 123 , 0 , 1 , 1 T_e — Sets the Unit field for the List function to Yes for personal text
〈TCT〉 — The control character commands the 2313 to take control

Notes

Function no. 123 in Table 6.4 is used for setting the UNIT field in the Set-Up and can only be accessed over the interface.

The system controller must not operate the 2313 until the function is executed and the 2313 has passed the control back to the system controller. See Section 6.7 for further information on passing control.

The 2313 gives up control on completion of the function, therefore this Job should be preceded by RETURNADR (Section 6.6.8). The selected 2313 function will be initiated on passing control to the 2313.

6.6.3. MASTER

Allows the 2313 to be controlled manually using the front panel pushkeys (or remote terminal — see Section 7).

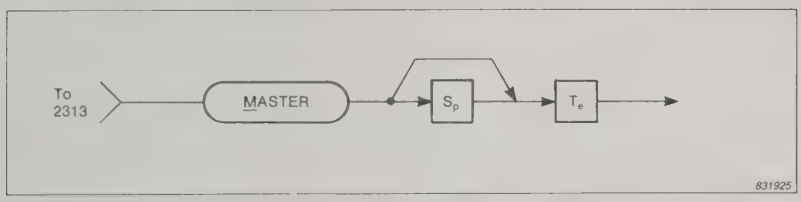

Fig. 6.6. Syntax diagram for controlling the 2313 via the front panel

Example of Use

MASTER T_e
〈TCT〉 — The system controller passes control to the 2313.

Notes

This Job should be followed by passing control of the bus to the 2313, see Section 6.7. Control is released when 'Reset' is activated. The system controller may take control by sending 〈IFC〉.

6.6.4. NEWSETUP

Specifies which of the 4 Set-Ups is to be the current Set-Up.

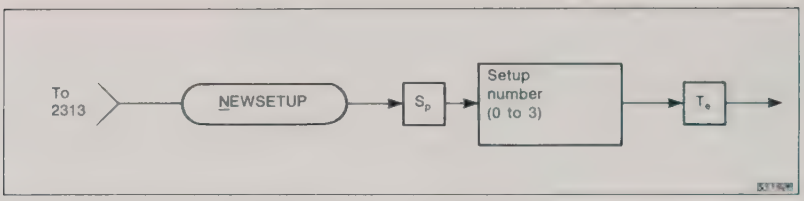

Fig. 6.7. Syntax diagram for selecting current Set-Up

Example of Use

NEWSETUP 2 T_e Selects Set-Up number 2 to be the current Set-Up

6.6.5. PAGE

The remainder of a page will be fed.

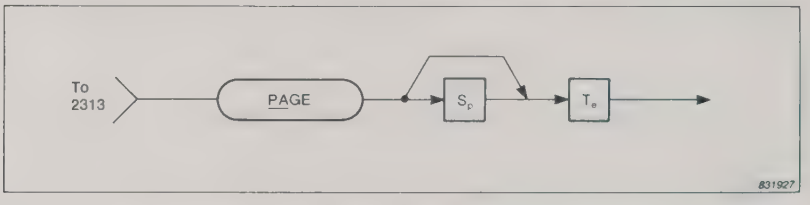

Fig. 6.8. Syntax diagram for paper feed of the remainder of the page

Example of Use

PAGE T_e

Notes

The page size is determined by the setting of the **Address Switch** pair 7.

6.6.6. PRINTER

Brings the 2313 to work in a printer mode as described in Section 6.12.

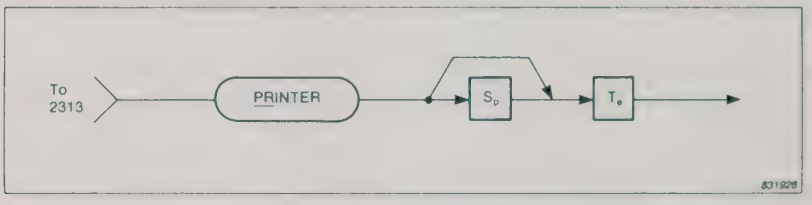

Fig. 6.9. Syntax diagram for selecting printer mode

Example of Use

PRINTER T_e

Notes

Once set, the 2313 will remain in the printer mode until cleared remotely (Section 6.11), or by pressing **Reset** on the front panel.

6.6.7. REPEAT

Repeats the previously executed FUNCTION or TEST. Has the same effect as pressing **Exec./Ent.** in manual mode.

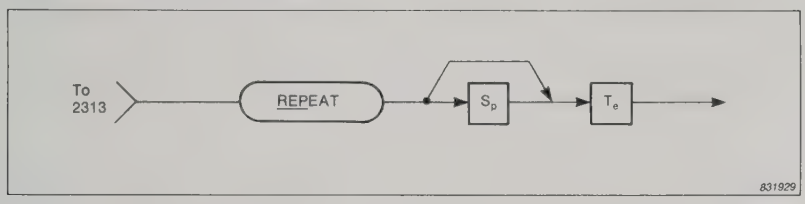

Fig. 6.10. Syntax diagram for repeating previous FUNCTION or TEST

Example of Use

RETURNADR S T_e
REPEAT T_e
〈TCT〉

The control character 〈TCT〉 commands the 2313 to take control.

Notes

See Section 6.7 for further information on passing control.

The 2313 gives up control on completion of the function, therefore this Job should be preceeded by RETURNADR (Section 6.6.8). The selected 2313 function must be started by passing control to the 2313.

The system controller must not operate the 2313 until the repeated function is executed and the 2313 has passed the control back to the system controller. This time depends heavily on the repeated function.

6.6.8. RETURNADR

Specifies the address to which control should be returned on completion of a function which requires that the 2313 has control over the interface. This specification must always precede the following jobs: FUNCTION, MASTER, REPEAT, TEST.

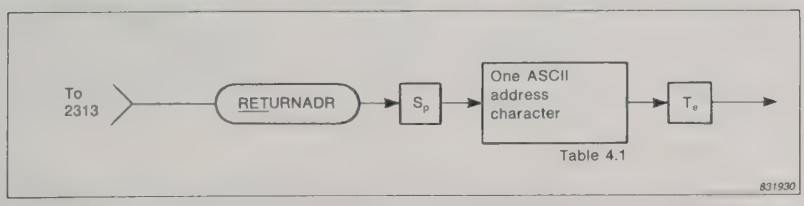

Fig. 6.11. Syntax diagram for specifying return address

Example of Use

RETURNADR U T_e

Enables control to be returned to a system controller with an address corresponding to the ASCII character 'U' (decimal 85)

Notes

This return address will be remembered by the 2313 until the 2313 is cleared by 〈DCL〉, 〈SDC〉 or in the case of an aborted function by 〈IFC〉.

6.6.9. SETUP

Enables new parameter values to be added to the current Set-Up.

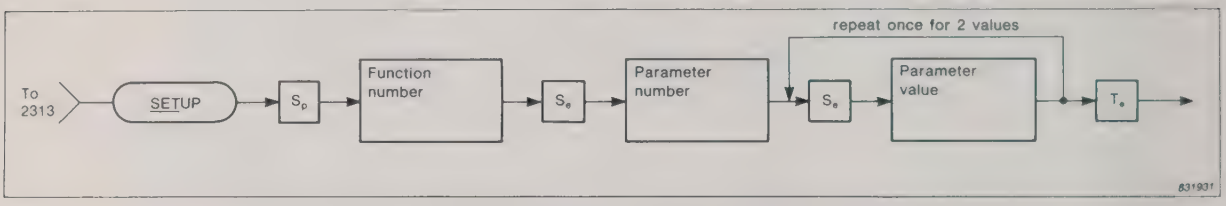

Fig. 6.12. Syntax diagram for changing Set-Up values

Example of Use

SETUP 0 , 4 , 500 T_e	List from 500 Hz
Wait	
〈SDC〉	
SETUP 2 , 1 , 3 , 12 T_e	Memory 3 to 12 store-secured
Wait	
〈SDC〉	
SETUP 12 , 3 , 10 T_e	10 records for probability distribution
Wait	
〈SDC〉	
SETUP 29 , 1 , 500 T_e	Pivot point for integration to 500 Hz
Wait	
〈SDC〉	
SETUP 201 , 2 , 2 T_e	second harmonic selected.
Wait	
〈SDC〉	

Notes

Note the necessity of sending an 〈SDC〉 or a 〈DCL〉 after each Set-Up command. After the SETUP command and before the clear, a wait of 20 msec. is necessary. A check as described in Section 6.7 and 6.8 may be performed.

From the list in Fig. 6.13 of the BZ 7002 functions, one can obtain function numbers, parameter numbers and values. This list contains default values i.e. from Set-Up 0. A Set-Up list for the BZ 7003 functions would be the same except that sub-functions 26 and 27 would be omitted and '2033 scale' would be replaced by '2031 scale'. Note that it is not possible to change the UNIT using the SETUP function, instead use function no. 123 (see Section 6.6.2).

The parameter values **Yes** and **No** are selected by writing –1 for **Yes** and 0 for **No**.

To select another Set-Up, use NEWSETUP (Section 6.6.4).

```
SELECTED SETUP NO.: 0
   FUNCTION              PARAMETER                        VALUE        UNIT
    0 List               1 Personal text          : NO
    0 List               2 List from              :    0.0000E+00      s
    0 List               3 List to                :  200.0000E-03      s
    0 List               4 List from              :   50.0000E+00     Hz
    0 List               5 List to                :   20.0000E+03     Hz
    0 List               6 Sampling reduction     :        5
    1 Plot               1 Personal text          : NO
    1 Plot               2 Scaling                : 2033 scale
    1 Plot               3 Log. full scale level  :  110.0000E+00     dB
    1 Plot               4 Lin. full scale level  :    1.0000E+00
    2 Memory             1 Store-secured          :       -1       -1
    3 Contin. memory     1 Store-secured          :       -1       -1
    5 2033               1 Move stored settings   : YES
    6 Delete             1 Memory secured         :       -1       -1
    6 Delete             2 Contin. memory secured :       -1       -1
    9 Record spectra     1 Control                : Time
    9 Record spectra     2 Time between spectra   :        1        s
   10 Plot av. spectra   1 Extra curves           : None
   10 Plot av. spectra   2 Averaging              : Arithmetical
(/  1) 11 Prob. density  1 Amplitude classes      :      100
(/  1) 11 Prob. density  2 Suppress σ - marks     : NO
(/  1) 11 Prob. density  3 Number of records      :        1
(/  2) 12 Prob. distribution 1 Amplitude classes  :      100
(/  2) 12 Prob. distribution 2 Suppress σ - marks : NO
(/  2) 12 Prob. distribution 3 Number of records  :        1
(/100) 110 Personal text 1 Enable line 0          : NO
(/100) 110 Personal text 2 Enable line 1          : NO
(/100) 110 Personal text 3 Enable line 2          : NO
(/100) 110 Personal text 4 Enable line 3          : NO
(/100) 110 Personal text 5 Enable line 4          : NO

SUBFUNCTIONS:
   21 Difference         1 Spectrum gain          :        0          dB
   21 Difference         2 Calculation            : Arithmetical
   26 1/3 oct. spectrum  1 Signal type            : Stationary
   27 1/1 oct. spectrum  1 Signal type            : Stationary
   29 Integration        1 Pivot point            :   10.0000E+03     Hz
   30 Differentiation    1 Pivot point            :   10.0000E+03     Hz

COMMON SETUP:
  200 Level              1 Select unit:   U =     :                   V
  200 Level              2 Calibration factor     :    1.0000E+00     V/ U
  200 Level              3 dB reference           :    1.0000E-06     U
  200 Level              4 Spectrum type          : RMS               U
  201 Frequency          1 Scale                  : Selected scale
  201 Frequency          2 Selected harmonic      :        1
  201 Frequency          3 Sel. harm. frequency   :   50.0000E+00     Hz
  201 Frequency          4 Calculate THD          : NO
  201 Frequency          5 Frequency unit         :                   Hz
  202 Time               1 Zero point             : Start of record
```

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Fig. 6.13. 2313 listing of BZ 7002 functions with function numbers, parameters with parameter numbers and default values

6.6.10. SHOWTIME

Results in a print-out of date and time.

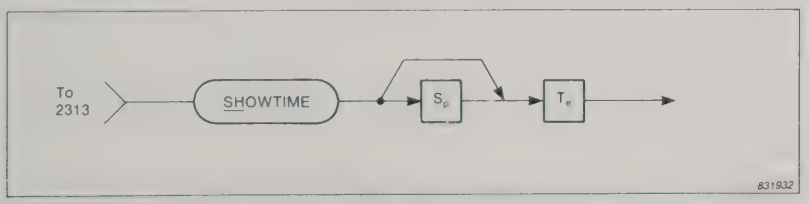

Fig. 6.14. Syntax diagram for read-out of date and time

Example of Use

SHOWTIME T_e

6.6.11. SRQENABLE
SRQDISABLE

SRQENABLE enables the 2313 to send out a service request (SRQ) in the case of a Job specification error, an error during the Job, or lack of paper.

SRQDISABLE disables the 2313 from sending out a service request.

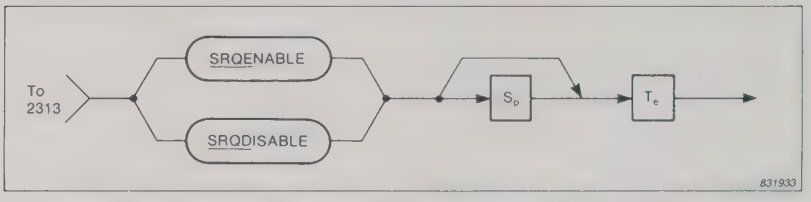

Fig. 6.15. Syntax diagram for SRQ enabling and disabling

Example of Use

SRQENABLE T_e

Notes

When an error occurs, the 2313 will lock until a serial poll has been carried out (see Section 6.10), or until the 2313 is cleared (See Section 6.11).

6.6.12. TEST

Carries out a test of the 2313 and gives a print-out for inspecting the printer head quality.

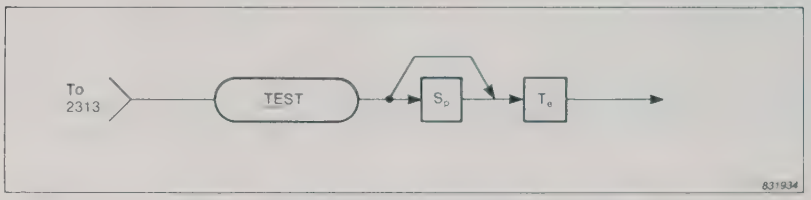

Fig. 6.16. Syntax diagram for 2313 self-test

Example of Use

RETURNADR W T_e
TEST T_e
〈TCT〉 The control character 〈TCT〉 commands the 2313 to take control

Notes

See Section 6.7 for further information on passing control.

This command must be preceded by RETURNADR (Section 6.6.8), for returning control on completion of the test, and control should be passed to the 2313 in order to start the test. The system controller must not operate the 2313 until the test is finished and the 2313 has passed control back to the system controller (approx. 3 minutes).

6.6.13. TEXT0
TEXT1
TEXT2
TEXT3
TEXT4

Inserts text in the relevant textline.

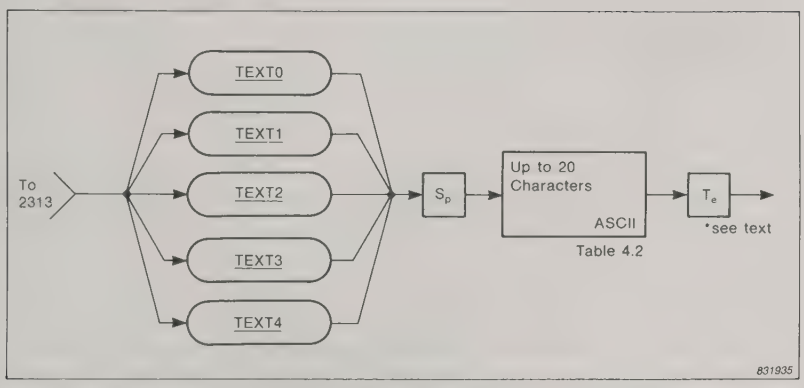

Fig. 6.17. Syntax diagram for inserting text in the read-out textlines

Example of Use

TEXT0 1/3 Octave Spectrum 〈EOI〉 Inserts '1/3 Octave Spectrum' in textline 0 (top textline)

Notes

* 〈EOI〉 with the last character should be used as T_e and not 〈LF〉. If, however, the control characters including 〈LF〉 are used, then the special characters from Table 6.6 will appear in the text field, e.g., 〈LF〉 would give a ^{0}.

Each textline contains a maximum of 20 characters.

6.6.14. TOPPAGE

The current position will be defined as the top of page.

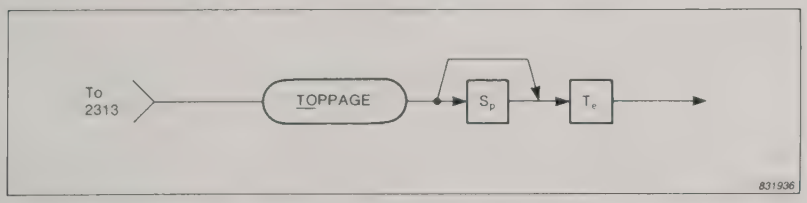

Fig. 6.18. Syntax diagram for setting the current position to top of page

Example of Use

TOPPAGE T_e

6.7. CHECKING THE JOB SPECIFICATION

During the development phase of the control program, it will be useful to know whether the job specifications sent to the 2313 are correct. In this case, the system controller must look for a Service Request 〈SRQ〉 message on the bus, (if service request is enabled), until the 2313 has checked the message.

It is important that the Take Control 〈TCT〉 message, if relevant, is not sent until the check is finished, as it is impossible for the system controller to perform a serial poll after it has passed the control to the 2313.

6.8. CHECKING FOR JOB ERRORS

Even if the job specification syntax is correct, the parameter numbers or values may be wrong.

While waiting for the 2313 to carry out its job, look for a possible service request 〈SRQ〉 message from the 2313.

Note that errors detected by the 2313 while having the IEC control, will lock the 2313 and can therefore not be investigated by the system controller. Such errors require an interface clear 〈IFC〉 which must be sent by the system controller after it has waited unsuccesfully for the job to finish. However, if the error is due to lack of paper, the 2313 will not lock but will send a service request 〈SRQ〉 message, if enabled, after it has completed the job.

6.9. ERRORS BY REMOTE CONTROL

Some typical errors which can occur are:

1. Forgetting to specify the return address for the system controller when required will result in:

   Job specification error Error No.: 18

2. Forgetting to pass control to the 2313 when required gives after about 5 seconds:

   IEC timeout Error No.:19

3. Misspelling job specifications gives:

   Job spec. error Error No.:18

4. Operating the system controller before the 2313 has passed the control back to the system controller will probably result in an error message from the system controller.

5. Wrong parameter no. or value used in SETUP gives various Error print outs — see error list in section 4.6.

For error printouts other than mentioned here please see the error list in section 4.6.

6.10. POLLING THE STATUS OF THE 2313

If the Service Request function is enabled (see Section 6.6.11), an error will cause an SRQ (Service Request signal — see Section 6.7 and 6.8). To locate the device asking for service and to get information about the cause of the error, a serial poll can be carried out by the system controller. The status byte of the 2313, read by the system controller carries the information stated in Table 6.5.

Bit No.	Status Message
8	*(not used and set false i.e. 0)*
7	2313 is asking for service
6	2313 is in an abnormal condition
5	2313 is busy carrying out a job
4	2313 is out of paper
3	*(not used and set false i.e. 0)*
2	2313 has detected a Job error
1	2313 has detected a Job specification error

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Table 6.5. Table of 2313 Status Messages

At the same time as bit 4 is set the 2313 will print:

Printing not allowed – Do check paper roll ERROR NO.: 0

If bit 1 is set, the 2313 will print:

Job specification error ERROR NO.: 18

and if bit 2 is set, the 2313 will print an Error No. other than 18 — refer to Error Code list.

A serial poll will clear this error condition if service request is enabled, otherwise a clearing by 〈DCL〉 or 〈SDC〉 has to be carried out (See Section 6.11).

Another method of polling the 2313 is the Parallel Poll. After the polling sequence is made by the system controller, a parallel poll will give the same information as bit 5 in the serial poll status byte. If an error is detected by Parallel Poll, a clearing by 〈DCL〉 or 〈SDC〉 must be carried out.

6.11. CLEARING THE 2313 VIA THE BUS

Device Clear 〈DCL〉 or Selected Device Clear 〈SDC〉

A Reset of the 2313 will be made clearing print buffer and job specification buffer as well as a running job. Stored memory files and interface functions will not be cleared.

Interface Clear 〈IFC〉

If the 2313 has been manually brought to the 'printer' mode, the 〈IFC〉 will cause both a Reset as for a 〈DCL〉 and a reset of the interface functions. The same will be the result if the 2313 is locked by an error while having the IEC control.

If the 2313 previously has been remotely operated without locking by errors, then only the interface functions will be reset.

If a job requires that the 2313 has control over the bus, an 〈IFC〉 must not occur until the 2313 has finished its job and has given the control back to the system controller in an orderly way except in the case of a locking error.

Note: To ensure that a job will be executed, it is necessary to wait a certain time between job specifications and while the 2313 is being cleared.

6.12. PRINTING WITH THE 2313/BZ 7002/3

The following procedure for printing data transferred over the interface bus applies when the 2313 is in its 'printer' (or listen only) mode. This can be achieved manually as outlined in Section 6.4.1 or by addressing the 2313 and sending the job specification PRINTER as described in Section 6.6.6. The 2313 will then be in its 'printer' mode, accepting ASCII characters sent over the interface bus and printing them out on receipt of 〈LF〉 (Line Feed), 〈EOI〉 (End Or Identify), or when the 2313's buffer is full. Characters are stored in sequence in the buffer and are printed out with automatic line feeds inserted in the case of overflow.

By sending the appropriate command, given overleaf, the ASCII printer format can be altered, or the 2313 brought into its graphic mode. The 2313 can be unaddressed to isolate it from interface bus activity, however when re-addressed, the 2313 will remain in its 'printer' mode. Deactivating the 'printer' mode is achieved by sending DEVICE CLEAR or SELECTED DEVICE CLEAR (see Section 6.11), or by manually activating any of the Reset levels (see Section 3.4).

The 2313 can print out all the non-control ISO characters as well as a range of special characters after receiving the ISO control character 〈SO〉 (see below). The range of control characters and their influence on the 2313 when in the 'printer' mode are listed below:

〈LF〉 Produces a line feed i.e. the current line is terminated and a new line started.

〈FF〉 Produces a form feed i.e. the current page is terminated and a new page started.

〈SO〉 The ISO characters between decimal 64 and 95 are replaced by special characters as shown in Table 6.6. This is maintained as long as the 2313 is in the 'printer' mode or until 〈SI〉 is sent.

〈SI〉 Returns the standard ISO character set if previously changed by sending 〈SO〉.

〈ESC〉 Notifies the 2313 of the start of a sequence, terminated by a ':', to change the printer format in 'printer' mode, or to access the graphic mode (see Sections 6.12.1 and 6.12.2).

The use of 〈SO〉, 〈SI〉 and 〈ESC〉 sequences conform to ISO 2022 (Code Extension Techniques).

Bit Numbers b_4 b_3 b_2 b_1	b_8 / b_7 / b_6 / b_5 0 0 0	0 0 0 1	0 0 1 0	0 0 1 1	0 1 0 0	0 1 0 1	1 0 0	1 0 1	1 1 0	1 1 1
0 0 0 0	NUL	DLE	SP	0	@ Δ	P π	`	p
0 0 0 1	SOH	DC1	!	1	A α	Q ∫	a	q
0 0 1 0	STX	DC2	"	2	B ²	R æ	b	r
0 0 1 1	ETX	DC3	#	3	C Σ	S σ	c	s
0 1 0 0	EOT	DC4	$	4	D δ	T τ	d	t
0 1 0 1	ENQ	NAK	%	5	E €	U ü	e	u
0 1 1 0	ACK	SYN	&	6	F φ	V √	f	v
0 1 1 1	BEL	ETB	'	7	G ω	W _	g	w
1 0 0 0	BS	CAN	(	8	H Ω	X ↑	h	x
1 0 0 1	HT	EM	)	9	I ⁰	Y ↓	i	y
1 0 1 0	LF	SUB	*	:	J ⁰	Z →	j	z
1 0 1 1	VT	ESC	+	;	K Ø	[←	k	{
1 1 0 0	FF	FS	,	<	L λ	\ –	l	¦
1 1 0 1	CR	GS	–	=	M μ	] –	m	}
1 1 1 0	SO	RS	.	>	N ±	¯ |	n	~
1 1 1 1	SI	US	/	?	O ■	– |	o	DEL

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Table 6.6. Table of ASCII (ISO 646 equivalent) characters showing also the special characters available on the 2313

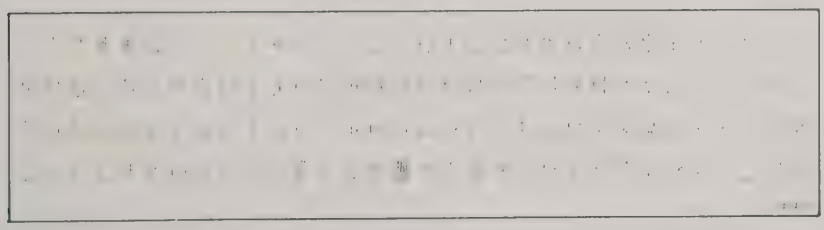

Fig. 6.19. Sample print out from the 2313 showing the alphanumeric characters available

6.12.1. Changing the Printer Format in 'Printer' Mode

Each standard character occupies a space of 8 pixels high by 6 pixels wide. The character height, distance between characters, line spacing can be altered as well as adding an underline. Fig. 6.20 gives the syntax of the sequence used to alter the format. The character height is a number between 1 and 4 (default is 2), where 1 is 1/2 of the standard height, 3 is 3/2 times the standard height etc. The space between characters is between 0 and 5 pixels (default is 0). The space between lines is between 0 and 7 pixels (default is 2). The underline feature underlines the following line only and is cancelled on receipt of ⟨LF⟩.

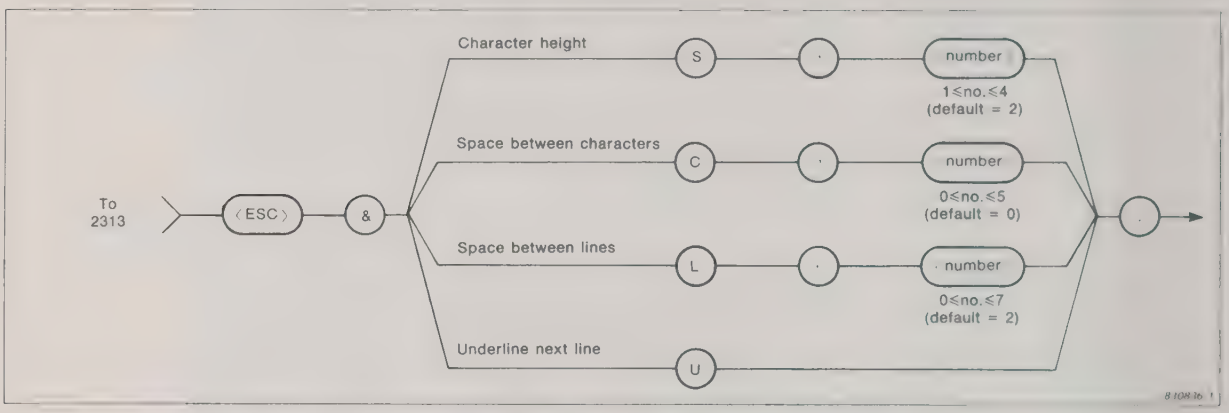

Fig. 6.20. Syntax diagram for altering the standard character format

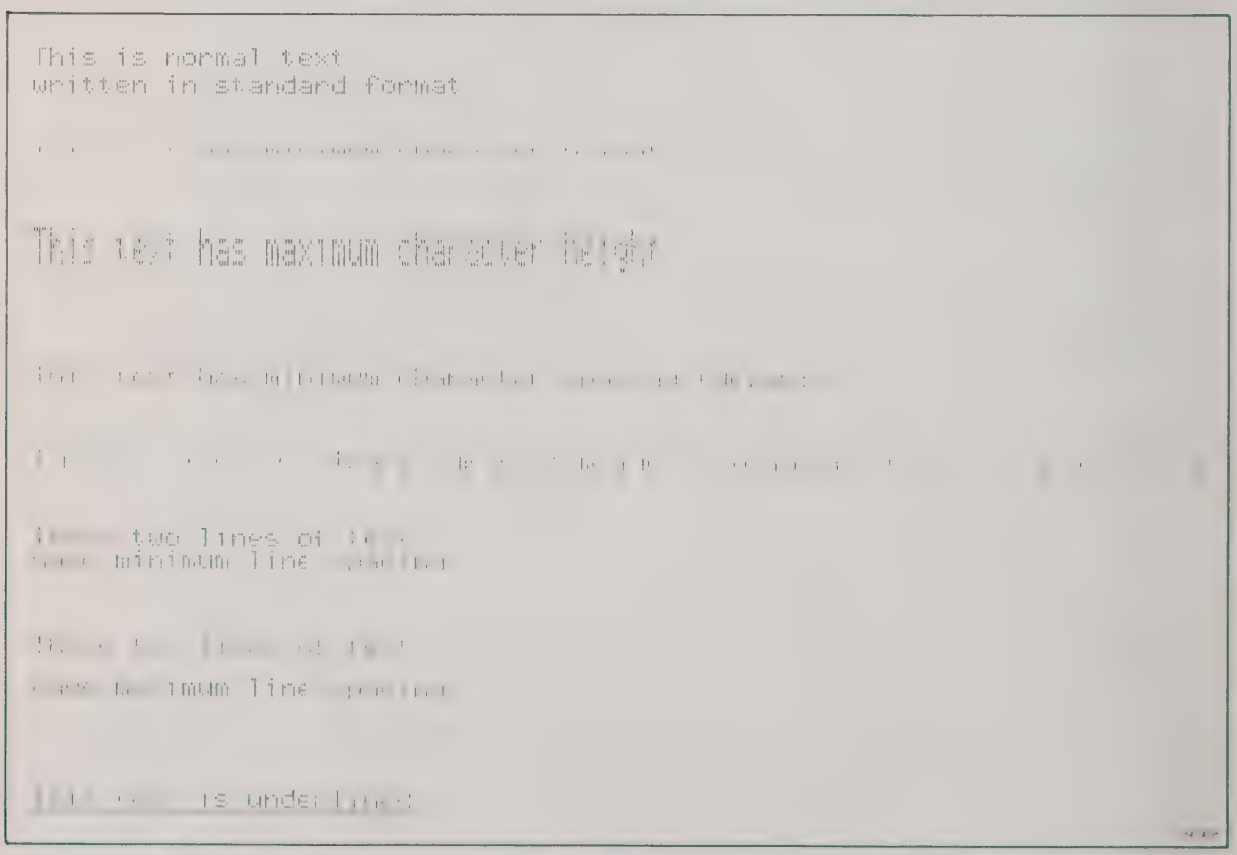

Fig. 6.21. Sample print out from the 2313 showing various format possibilities

6.12.2. Changing to Graphic Mode

In the graphic mode, the binary data sent to the 2313 activate the pixels directly. Fig. 6.23 gives the syntax used when printing in graphic mode with an example of the construction of one graphic line given in Fig. 6.22. This specifies what binary data follows this ⟨ESC⟩ sequence and it is important that the following data is as specified. On completion of the graphic print-out, the 2313 returns to the normal ASCII mode. At this point and not before, a further ⟨ESC⟩ sequence can be initiated. The number of graphic lines is from 1 to 999 (default of 1). The number of graphic bytes per line is from 1 to 64 (default of 64 which is one complete line). The Graphic line start point is from 0 to 63 (default is 0 i.e. start at first line). Fig. 6.24 gives an example of a program, written for demonstrating the graphic mode. An example of the print-out obtained from this program is given in Fig. 6.25.

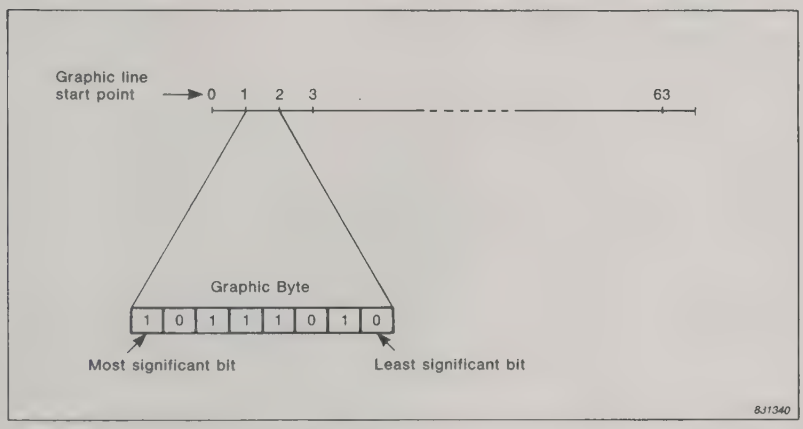

Fig. 6.22. Example of the construction of one graphic line

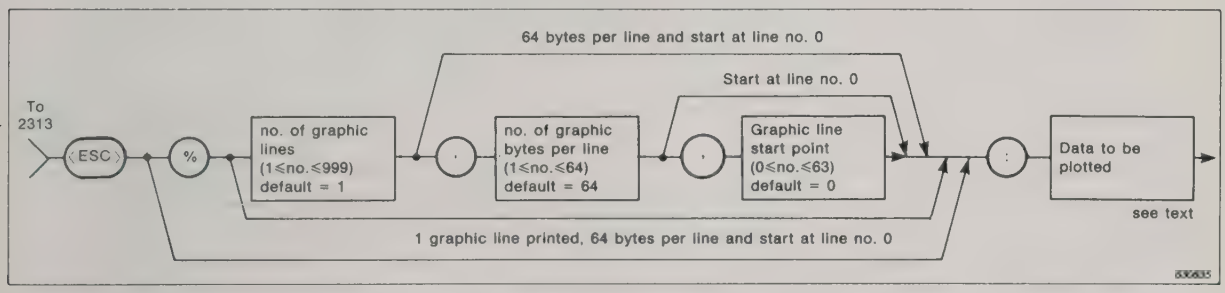

Fig. 6.23. Syntax diagram for plotting in the graphics mode

```
10    !
20    ! The following program reads in 30 values and generates a graphic
30    ! picture on the 2313 showing the values as a histogram.
40    !
50    ! The program is written on an HP 9826 with BASIC 2.0 System.
60    !
70    ! 2313 should be set to 'System Controller, Not Active' mode and the
80    ! address should be set to decimal 1.
90    !
100   !
110   COM Hist(1:30)                    ! The array 'Hist' is used for data.
120   INTEGER Pixel_array(0:200,1:30)
130   !
140   ! The array 'Pixel_array' is used to store 201 pixel-lines of 30 graphic
150   ! bytes (240 bits). Each graphic byte represents one channnel and is
160   ! stored as INTEGER's.
170   !
180   Min=1.E+9
190   Max=1.E-9
200   !
210   ! Read in data from keyboard:
220   !
230   FOR Ch=1 TO 30
240     DISP "VALUE CHANNEL";Ch;
250     INPUT Hist(Ch)
260     IF Hist(Ch)>Max THEN Max=Hist(Ch)  ! Find maximum
270     IF Hist(Ch)<Min THEN Min=Hist(Ch)  ! Find minimum
280   NEXT Ch
290   !
300   Range=Max-Min     ! Autoscaling
310   Plot_range=200    ! 200 pixel-lines are used for data
320   All_pixels=255      All 8 bits in one graphic byte is 1
330   No_pixels=0         All 8 bits in one graphic byte is 0
340   First_pixel=128     First bit (most significant bit)  = 1
350   Last_pixel=1        Last bit (least significant bit)  = 1
360   !
370   ! Generate the top frame line:
380   !
390   FOR Ch=1 TO 30
400     Pixel_array(200,Ch)=All_pixels  ! Set all  8 bits in the byte to 1
410   NEXT Ch
420   !
430   ! Generate the data lines from top to bottom:
440   !
450   FOR Line=199 TO 1 STEP -1
460     FOR Ch=1 TO 30
470     IF Hist(Ch)-Min>=(Plot_range*Line-Plot_range*Range) THEN
480       Pixel_array(Line,Ch)=All_pixels                ! Set all 8 bits to 1
490     ELSE
500       Pixel_array(Line,Ch)=No_pixels                 ! Set all 8 bits to 0
510       IF Ch=1 THEN Pixel_array(Line,Ch)=First_pixel  ! Set left frame bit
520       IF Ch=30 THEN Pixel_array(Line,Ch)=Last_pixel  ! Set right frame bit
530     END IF
540     NEXT Ch
550   NEXT Line
560   !
570   ! Generate the bottom frame line:
580   !
590   FOR Ch=1 TO 30
600     Pixel_array(0,Ch)=All_pixels  ! Set all 8 bits in the byte to 1
610   NEXT Ch
620   !
630   CLEAR 701
635   WAIT .5
640   OUTPUT 701;"PRINTER"
650   OUTPUT 701;CHR$(10);CHR$(10)
660   !
670   ! Print text:
680   !
690   OUTPUT 701;"
700   !
710     Dump the picture as 6030 bytes:
720   !
730     No. of lines: 201
740     No. of bytes per line:
750     Start point for all lines: 10
760   !
770   OUTPUT 701 USING "#,B,W030-B";CHR$(27)&"*",201,
780   !
790   !
800   ! Print text:
810   !
820   OUTPUT 701;CHR$(
830 CHR$(10);CHR$(10)
840   !
850   END
```

Fig. 6.24. Example of a program to demonstrate the graphic mode of the 2313

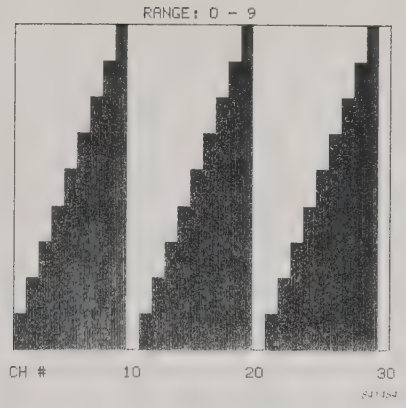

Fig. 6.25. Read-out obtained when running the program example in Fig. 6.24

7. THE SERIAL INTERFACE

7.1. INTRODUCTION

The Serial Interface in the 2313 conforms to the EIA Standard RS 232C (equivalent to CCITT V.24). This standard ensures voltage level compatibility, identical pin wiring, and that certain control information supplied by one device can be understood by other devices. However, it is important to note that the interface may be used in various ways and that it is allowed to use more or less simple subsets of the standard.

To operate the interface is not only a matter of sending understandable data between the devices, but also to ensure that the device uses the number of control lines which is needed by the other device, that the number of bits and stop bits is correct and that the same baud rate, (data flow in bits per second), is selected in the two devices.

The following specifications apply to the Serial Interface of the 2313:

Number of bits: 8
Number of stop bits: 2
Parity: No
Mode of operation: Full duplex
Baud rate: 75 – 9600 Baud
Output level: ± 7 Volt nominal
Connector: 25-pin female
Synchronization method: None

The 2313 is coupled as a "Data Communication Equipment (DCE)" which is also called a modem. The device which is connected to the 2313 will normally be a "Data Terminal Equipment (DTE)" and have a 25-pin male connector. The baud rate may be selected up to 9600 baud, but in cases where a block of more characters are following rapidly after each other, it may be advisable to use a lower baud rate.

List of pins used:

1.	Protective ground	connected for chassis
2.	TDATA	Data **to** the 2313 (input)
3.	RDATA	Data **from** the 2313 (output)
5.	CTS	Clear to send (output)
6.	DSR	Data set ready (output)
7.	Signal Ground	Common return
8.	DCD	Data carrier detect (output)
20.	DTR	Data terminal ready (input)

The signals CTS, DSR and DCD are held true (high level) whenever the 2313 is turned on. The signal DTR is expected to be true but may in most cases be left unconnected. Consult the manual for the Data Terminal Equipment for possibly needed control signals.

7.1.1. Setting the 2313 Baud Rate

When a terminal is connected to the 2313 via its RS 232 interface and 'Reset' pressed, it is possible to insert personal text via the terminal or to remotely control the 2313. Before operating the terminal it may be necessary to set the baud rate to match that of the 2313 (factory set to 9600 bits/sec.). If necessary, the 2313 baud rate can be altered in multiples of 2 from 9600 to 75 bits per second, by altering the jumper plug to a new position as shown in Fig. 7.1. The jumper plug is located on the printed circuit board on the inside of the back panel, accessible by removing the two screws securing the top panel and sliding the panel back. Ensure the mains power is disconnected before attempting to remove the top panel.

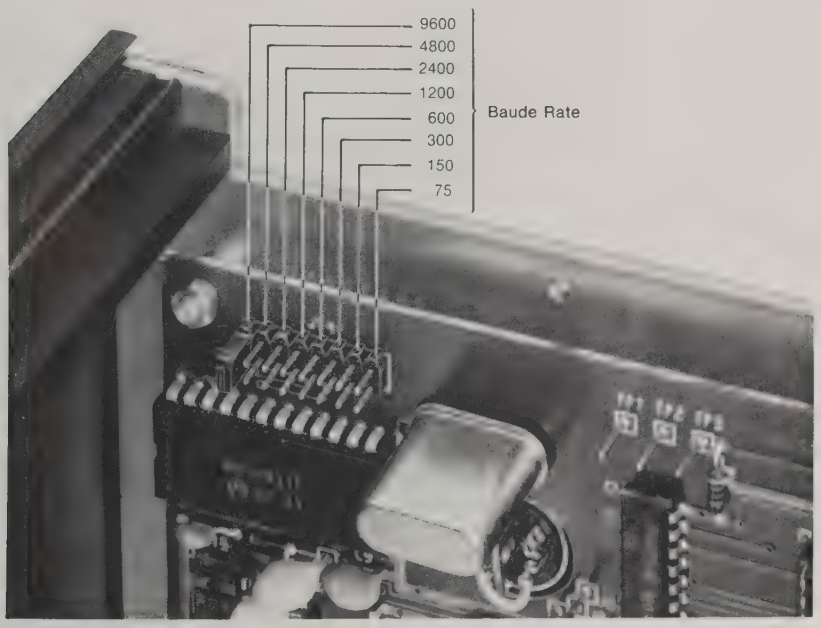

Fig. 7.1. Location of jumper plug for changing the baud rate

7.1.2. Personal Text

Prior to typing in the text, one of the textlines has to be selected then the characters can be typed in directly. Table 7.1 gives a list of the relevant pushkey commands.

Terminal	Result
G_c 0	select textline 0
G_c 1	Select textline 1
G_c 2	Select textline 2
G_c 3	Select textline 3
G_c 4	Select textline 4
G_c C	Clear selected textline and return to first character position
G_c T	Remote control of 2313 front panel, see Table 7.3
Another ASCII Control Character	A special character is put in the current position of the selected textline then incremented to the next character position, see Table 7.2
G_c 〈other ASCII character〉	Return to first character position in the selected textline
ASCII Character	The character is put in the current position of the selected textline then incremented to the next character position

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Table 7.1. Remote terminal pushbutton commands, where suffix c denotes a control character

In addition to the standard ISO characters, special characters can be entered from a list of control characters according to Table 7.2, e.g., N_c (Control N, equivalent to ISO control character SO) would give a ±.

Terminal	ISO	2313 Char.	Terminal	ISO	2313 Char.
$@_c$	NUL	Δ	P_c	DLE	π
A_c	SOH	α	Q_c	DC1	¡
B_c	STX	²	R_c	DC2	æ
C_c	ETX	Σ	S_c	DC3	σ
D_c	EOT	δ	T_c	DC4	τ
E_c	ENQ	ε	U_c	NAK	ü
F_c	ACK	φ	V_c	SYN	¡
H_c	BS	Ω	W_c	ETB	–
I_c	HT	°	X_c	CAN	'
J_c	LF	°	Y_c	EM	,
K_c	VT	Ø	Z_c	SUB	'
L_c	FF	λ	$[_c$	ESC	'
M_c	CR	μ	$_c$	FS	¯
N_c	SO	±	$]_c$	GS	_
O_c	SI	■	^{c}	RS	
			$-_c$	US	

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Table 7.2. Table of remote terminal commands for writing special characters in the textline, where suffix c denotes a control character

7.1.3. Remote Control of the 2313 Front Panel

It is possible to remotely activate the front panel pushkeys via the terminal. To set the terminal for remote operation, key in G_c (Control G, equivalent to ISO control character BEL) followed by 'T', thereafter the 2313 will be controlled by the terminal according to Table 7.3. Remote control will cease on pressing the letter 'O' on the terminal.

Terminal	2313 Front Panel	Terminal	2313 Front Panel
0	0	Y	Yes
1	1	E	E
2	2	N	No
3	3	/	/
4	4	W	Extension
5	5	C	Clear Entry
6	6	P	Page
7	7	H	Help
8	8	S	Setup
9	9	RETURN	Execute
–	–		
.	.	O	(cease remote control of 2313)

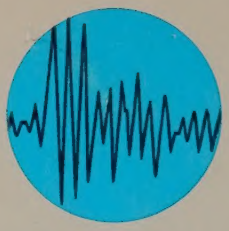
T00113GB0

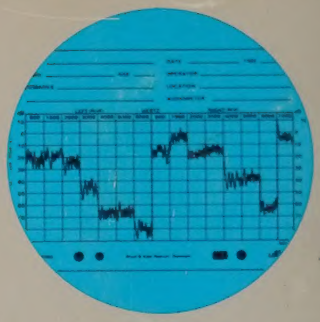
Table 7.3. Table of remote terminal commands for activating the 2313 front panel pushbuttons

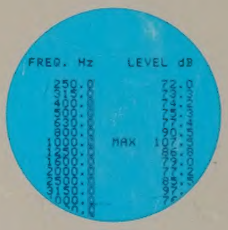
8. SERVICE AND REPAIR

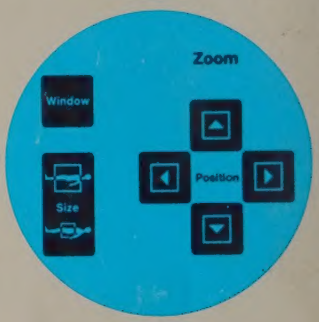
The 2313 is designed and constructed to provide the user with many years of safe, reliable operation. However, should a fault occur which impairs its correct function and possibly operating safety, then it should be immediately disconnected at the mains source and be secured against unintended operation. For repair consult the separate Service Instruction Manual for the instrument or contact your local B & K service representative. Under no circumstances should repair be attempted by persons not qualified in the service of electronic instrumentation.

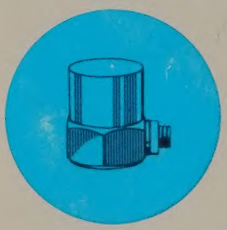
2313 + BZ 7002 and BZ 7003

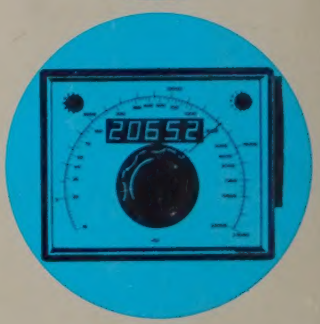


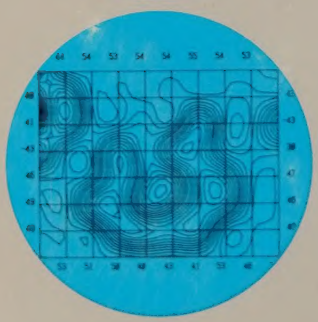


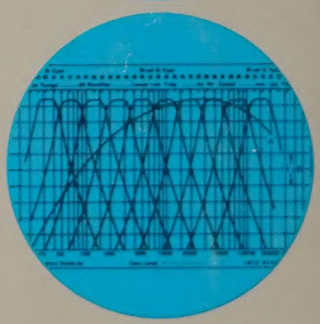












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